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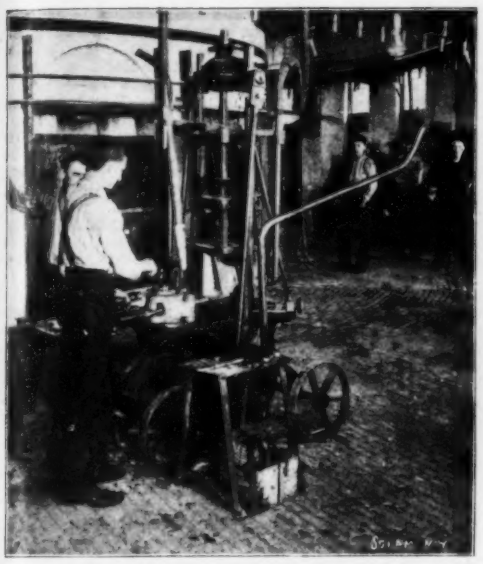
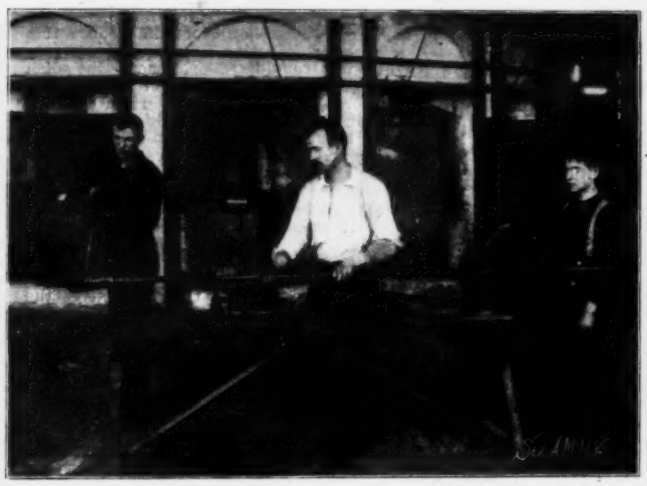


TESTING THE FLUX OF MOLTEN GLASS.



"GATHERING" THE MOLTEN GLASS ON RODS, READY FOR BLOWING.

FINISHING A CARAFE.

ONE OF THE PRODUCTS.

BLOWING THE MOLTEN GLASS INTO VASES, CUPS, AND OTHER FORMS.

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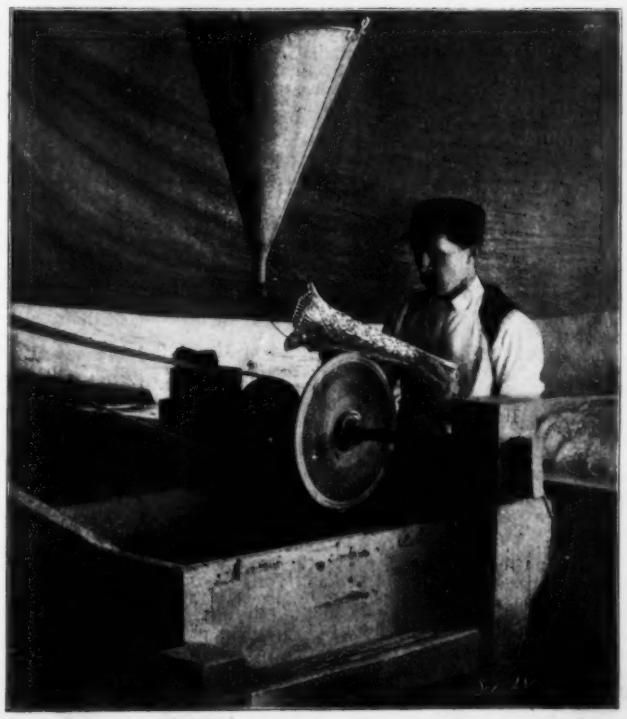

ORNAMENTING A VASE WITH FLORAL PATTERNS.

THE AMERICAN CUT-GLASS INDUSTRY.

THE PROCESS OF CUTTING GLASS DISHES.

By DAY ALLEN WILLEY.

ALTHOUGH it was nearly two hundred years ago that the Bohemian workman, Lehman, discovered a way in which to make patterns upon glass by cutting, this branch of the industry is comparatively modern, for the great variety of designs which have been conceived are the result of but a few years' experiments. American handicraft of this kind is undoubtedly superior to any in the world, although years before dishes made of cut glass came into common use in this country the industry flourished in England. Probably it would assume even larger proportions if the supply of raw material, as it might be called, was more abundant, for the flint glass which is worked by the cutter has its basis in a sand of a very fine quality. In this country the only practical supply thus far discovered exists in the Berkshire Hills in Massachusetts, and the manufacturers are compelled to pay a very high price per ton for it.

The per cent of silica in the sand forms one of its most valuable qualities, but it is necessary to mix other ingredients to form the proper basis for the glass. Each manufacturer has a formula known only to himself, and experiments are continually being made to improve the clear and iridescent properties with various preparations. The principal ingredients of the flint glass are sand, red lead with a small amount of refined potash and a little cullet. To bleach the material a small portion of white arsenic or manganese may also be employed. In fluxing operations, the first processes in the composition of ordinary glass are employed. The furnace is usually heated by gas, although petroleum is considered somewhat superior and is utilized where it can be secured in sufficient quantity. The crucibles or melting pots are made of fireclay mixed with pieces of old pots in a kind of dough. They are then melted, fired, annealed and glazed, so that the material will not mix with the flux. This step of the process requires great care, and several weeks usually elapse in the completion of the pots, although they last but a short period, owing to the intense heat to which they are exposed. The large pots hold 1500 pounds and over of glass, which must be subjected to a temperature of fully 2500 deg. Fahrenheit to reduce it to the opaque, rose-colored mass which is to be converted into the various dishes. While it is extremely ductile and can be molded, hammered and drawn, it is not in the fluid state like melted iron, and to this fact is due the wonderful ease with which it can be manipulated in the formation of the articles.

The vase, globe, carafe or other design emerges from the furnace in a chunk or ball of flux upon the rod of the "gatherer," who estimates the quantity required by guesswork, based upon long experience. The hollow rod with the flux is passed to the "blower," who, forcing air into its center, forms it into a ball, to be later rolled or pressed with special tools into the shape desired. While this process is one of the most intricate, requiring much dexterity, the annealing involves great delicacy also. Placed upon a board covered with asbestos or other fireproof material, the rough pattern of the dish is carried to the oven, the front of which is heated to a very high temperature, but the air is graduated until it is comparatively cool at the rear. The heat in the glass evaporates slowly as it is gradually moved back in the oven, and the danger of breaking or cracking by the sudden change of temperature is avoided. So fragile are the pieces after being blown and pressed, that even the thickest dishes will break almost instantly by an exposure when treated to a draught of cool air.

At this point in the industry begins the process which develops cut glass as it is known in commerce. Engraved glass is frequently confounded with the cut material. Patterns which are completed by stamping and molding are also mistakenly termed cut glass, but experts define it as material which has been ground and polished upon wheels of various materials. The series of operations termed cutting give the surface its brilliant, iridescent appearance, which is superior to any of the other designs which have thus far been manufactured. In fact, the cut glass is as superior to the pressed and acid-treated material as iron wrought by hand is superior to machine-made articles of the same metal.

Before cutting the figures to be wrought upon the dish, it is divided into equal sections with some composition which will not dissolve by the application of water. Usually a mixture of resin, turpentine and oxide of red lead is employed. If the design is very intricate at times, it may be traced upon the surface with a steel point, but the glass cutter is usually such an expert that he fashions the leaf, diamond or the star, depending almost entirely upon his eye and memory, the lines traced with the pigment being merely for measuring properly, so that the proportions may be exact. Cutting glass is really "roughing" it, for the material is eaten away by applying it to the rapidly-revolving metal wheels, the edges of which are covered with moistened sand. Water from above constantly drips upon the wheels from a reservoir, on the same principle that the farmer moistens his grindstone.

The size of the roughing wheels aided by the skill of the operator produce nearly all of the figures seen upon the surface of modern cut glass, although they are almost innumerable, the fashions of the design changing from time to time like those of the modiste and the milliner. Wrought iron and copper are the principal materials used in the roughing wheels. The iron wheels are called "millers" in the English works. In making shallow cuts stone and wooden wheels are occasionally used, but the metal wheels are principally depended upon for the first process. A wheel with a rounded edge is used for fluting and hollowing, the hollows and circles being produced by a slightly rounded edge. The deep and fine cutting is of course done with the narrow wheel, which is termed a "splitter." The edge of the split wheel, slightly flattened, performs what is called panel work, but most of the ornamentation is done by miter wheels, which in the hands of a skilled workman create really marvelous patterns. Taking the model as it comes from the annealing oven, the cutter applies it to the surface of the wheel, which traces vertical, horizontal and diagonal lines upon it almost as rapidly as the scroll saw cuts ornaments in the wood. Merely additional pressure of the surface to the wheel produces the deeper cutting, while rocking the model slightly from side to side broadens the opening to suit the design. The diamond pattern so familiar to admirers of cut glass is produced with the miter, while prisms are formed by applying the glass to its sides. These in turn become the edges of facets in the diamond by another movement, while the square-cut stars as well as diamonds, each having three to eight sides, are completed merely by moving the piece of glass in various directions against the miter. Buds are produced by gently rocking the dish as it is held against the wheel, while outlines of flowers and leaves are created by giving it a peculiar rolling motion only acquired by long practice. Floral patterns are one of the most popular designs on punch bowls, and as they must be made frequently on a hollowed or concave surface, this is considered one of the most delicate designs. The serrated and rounded edges so popular in cut glassware are made by what is called a panel wheel, which acts like a saw in producing the right angles. The round effect is then secured by application to the miter, although the "smoother" sometimes does this work, unless the article is very large.

After leaving the roughing department the dish contains the design, but the surface is of a dull color, and only the expert could distinguish it from common glass. To give it the brilliancy and luster so much desired, it must be smoothed and then polished. In this process stone and wooden wheels are used, also revolving at a high rate of speed. Great Britain furnishes the best stone so far discovered for the treatment of glass; the Yorkshire, Newcastle and Craigleith districts supply it principally. Roughly hewn into shape, the stones are purchased by the glass manufacturers and trued to the proper edge by abrasion. Then mounted upon axles, they are driven by shafting and belting. The contact of the stone gives the surface of the glass its smooth finish, although great care has to be taken lest too much of the material should be cut away and the dish thus destroyed; in fact, it requires a very straight and "true" eye in roughing and smoothing, as a notch of a quarter or an eighth of an inch may destroy the most costly vessel, for as is well known, the finest cutting is the deepest. The stone wheels are also mitered and of other shapes to correspond with the patterns to be finished. Wooden wheels for finishing and polishing have been supplanted largely in recent years by revolving brushes, also wheels having a felt surface, or buffers as they are sometimes termed. The wood preferred is willow, elder or cherry, as these varieties give a very lustrous appearance and do not leave any imperfections upon the surface if the polishing is properly done. The finish of the dish is another part which involves much care, but cut glass owes its popularity as an ornament very largely to the manner in which this process is carried out. Different ingredients have been used to enhance the polish, but the manufacturers of the best grades of American glass find that a mixture composed merely of putty in the powdered form and slightly moistened seems to answer the purpose best, although ground pumice stone is sometimes used.

Cut glass in this country has become so popular that it now rivals the precious metals in its sale in various forms for gifts. It combines not only art but usefulness, as the patterns include nearly all of the ordinary table dishes, such as pitchers, bowls, carafes, goblets and tumblers, while in the form of vases, jars and even lamps it ornaments the drawing-room as well as the chamber. Such progress has been made in the industry, that lamps are manufactured with shades, reservoirs and even pedestals made of this material. Probably the largest yet made was finished at the Libbey works in Toledo, Ohio, illustrated by the accompanying photographs. At this plant the famous punch bowl presented to President McKinley was executed. The bowl and pedestal combined weigh no less than seventy-five pounds, and over a month was required to complete the design of the stars, stripes and shields upon the surface of the pieces, although every portion of the work was performed by the wheels.

TEMPERATURE EXPERIMENTS WITH BUTTERFLIES.*

By DR. E. FISCHER, in Umschau. Translated for the SCIENTIFIC AMERICAN SUPPLEMENT.

RESULTS obtained by temperature experiments on butterflies furnish so much that is startling and have such unforeseen significance as to the question of the production and modification of species, and as to the difficult and important problem of hereditary transmission, that a brief explanation of these experiments is of interest and is instructive to circles of readers not limited to actual students of zoology.

Temperature experiments with butterflies have been made in the past decades by Dorfmeister, of Graz (1845), and later by Weismann, of Freiburg (1868). These students confined themselves almost altogether to the small variety of day butterflies, Vanessa levana L., whose peculiar conditions of coloring induced these two investigators, among others, to make the experiments in temperature. For Vanessa levana L. passes through two generations each year, one of which hibernates in the pupa condition and produces, in the spring, a levana L. with dark spots on a light brown ground. This levana produces a second generation of direct descent, which passes through all of its stages of development (the egg, caterpillar, pupa and butterfly) during the middle of summer and results in a variety (Vanessa prorsa L.) which is colored in an entirely different way, namely, black and white.

Dorfmeister and Weismann surmised that the differences of temperature which obtained during the development of these two generations (the winter generation and the summer generation) were the cause of the differentiations as to color, and experiments made on this ground verified the conjecture. They succeeded in producing a transitional form porima O., which closely approached the winter variety, by exposing the pupa of the black summer variety to a low degree of temperature about + 2 deg. C. This was a case of the change of a generation of one species into another generation of the same species. Nothing further was done, and it seemed as though the end had been reached. At any rate, there were no further experiments made after Weismann published his results. After a period of seventeen years a series of special temperature experiments made by me in the summer of 1892, reawakened interest in the matter, gave efforts a new direction and produced unexpected results.

The origin of the new experiments lay in studies made of a specimen of Vanessa Io L. (the familiar peacock butterfly) obtained *under perfectly normal conditions*. This specimen differed from the normal form by a black spot on the upper wing; a spot normal only in varieties closely related to this specimen. I signalized the appearance of this black spot in this situation, where it always appears in a related variety, as a case of atavism (retroversion) and since Weismann has made it appear that the effect of cold upon the pupa may produce such retroversions, as will appear from what follows, I determined at an early opportunity to expose pupæ of Vanessa Io L. to cold, with the expectation of producing this black spot in an artificial way.

The experiments begun in the fall of 1892 confirmed this expectation after some time.

The first experiment produced a most startling result in another respect. I placed fresh pupæ of the peacock butterfly into an ice-cellar and kept them there for three weeks at a temperature of + 3 deg. C. No entirely normal specimen was hatched. There was evolved an entirely new and hitherto unknown variety, which presented phenomena of the utmost importance in their reflex influence on the genealogical development of butterflies. For the product resembled in color and markings a different group of the same species, namely, Vanessa urticæ L. (smaller tortoise-shell) and thus gave unmistakable indications of its *derivation* from that group. This gave rise to the expectation that other varieties of Vanessa could also be changed by cold and that possibly points of approach might be established and a genealogical sequence confirmed. It was also to be expected that the treatment of pupæ under abnormal increase of temperature would result in modifications of the butterflies and in the creation of new forms. It was not therefore a matter of surprise that under such promising conditions the results of the first experiment of 1892 should be the cause of intense activity in this field.

My experiments, begun in the spring of 1893 in spite of many obstacles and inconveniences, were soon followed by those of other investigators, at first by Standfuss, then by Frings, Fickert and others. The different varieties of Vanessa in Central Europe were studied.

In experiments with low temperatures the pupæ were exposed to + 3 deg. C. from three to six weeks. In heat experiments the exposure was made from one to several days at temperatures ranging from + 35 deg. and + 38 deg. C., even to + 42 deg. C. Vanessa urticæ, L. (smaller tortoise-shell) on exposure to *cold* appeared with upper surface darkened, while in several specimens the under side was lighter, very much after the manner of the variety found in the polar regions, V. polaris Stgr. Several individual cases, however, passed even beyond this polaris stage and approached a form of urticæ found in the island of Jesso, marked by a broad black band lengthwise.

Heat produced the opposite, a lighter, predominantly red, coloring for the upper surface and a darker under surface, and thus a startling approach to the variety Ichnusa Bon. found in southern Europe (Corsica and Sardinia).

Similar results were obtained from Vanessa polychloros L. (larger tortoise-shell) which was modified directly into the variety called erythromelas Aust. (found in southern Europe and north Africa), while cold modified it into two new varieties, one with less distinct markings and a second with a largely increased series of black markings.

Vanessa Io L. seemed able to resist changes in temperature to a remarkable degree, so far as heat was concerned, remaining almost entirely normal, but cold resulted in the above-named new variety Fischeri Stdfs.

Vanessa antiopa L. (Camberwell Beauty or yellow-bordered butterfly) proved to be an exceedingly variable specimen and one furnishing important matter for investigation.

Subnormal temperatures darkened the brown fundamental color, narrowed down the yellow border and enlarged the blue spots. I named this beautiful butterfly Artemis Fschr. Supranormal temperatures changed antiopa into the very opposite of artemis. The fundamental color was lighter, the border wider and the blue spot decidedly smaller. I described this delicate variety of artemis as epione Fschr. in 1894.

In a similar way it was possible to change the summer generation, Polygonia C. album L., into the darker fall generation by exposure to cold and to make it approach the light southern European egea Cramer by exposure to heat.

Of course the Arachnia, variety prorsa L., previously examined by Dorfmeister and Weismann, were also subjected to experiment and resulted, through exposure to cold, in the hybrid variety porima O. delicately graded from the summer generation, prorsa L. to the winter form, levana L.

Finally there are the two varieties of Pyrameis: atalanta L. (red or scarlet Admiral) and cardui L. (Painted Lady or thistle butterfly). They behaved much like the above-mentioned varieties of Vanessa. The light forms artificially produced by heat resembled in every way those flying in southern regions, and those modified by cold resembled the dusky northern specimens. Cardui particularly resembled those specimens which have come to me from the northernmost regions of Europe and North America.

These experiments prove, as observed by Dorfmeister and Weismann, that a modified form of the butterfly was produced if the pupa was early exposed (that is, on one of the first three days of the pupa condition) to abnormal temperatures; for cold three to four or six weeks, for heat from two to four days

*The reader who is familiar with the import of these experiments in solving the most important biological problems, such as adaptation, heredity, selection, etc., will note that this article presents in detail remarkable results obtained in this line by the author.

uninterruptedly. Hence this period of the pupa condition is called the sensitive or critical stage.

From the results thus far cited we can make an important deduction: We have seen that our central European varieties, which we in general classify as the original forms and the pupæ of which were used in these experiments, can be artificially modified into northern local forms by cold and into southern forms by heat. They can, in fact, be directly changed into these forms. Hence the deduction that these local forms are climatic productions; hence, that the species is not unchangeable and that these modifications and changes experienced are brought about by the factors of environment, especially of temperature, and do not originate from the innate tendency of the individual. There has been a suspicion of this right along, and it has been assumed as a condition of probability, but the above investigations have furnished experimental proofs, and have removed the matter from the domain of surmise to that of certainty.

But our results go farther than this. As shown, our central European Urticæ L. was directly changed by exposure to cold into the polar variety, polaris Stgr. But this variety we have reason to believe is an old form, which has existed in its present or, at any rate, a very similar garb ever since the glacial epoch and which has been preserved until the present day by the fact, that in the post-glacial era, when the climate grew more temperate, it withdrew to the more northerly and colder regions; or if its habitat covered the northerly parallels in the glacial days, it has been there preserved owing to unchanged climatic conditions.

This leads to the startling conclusion, that urticæ can be artificially changed by cold into a form (polaris Stgr.) which existed in the glacial period; and since other varieties of Vanessa exhibit similar changes, the conclusion is applicable to them all.

These experiments therefore point the way to reproducing from the common central European Vanessa not only forms that existed ages and ages ago, and thus to produce atavistic or retrovertive phenomena, but also on the other hand to produce anticipatory or future forms, in other words, to create what has never yet existed.

The experiments, however, revealed another most important and extremely puzzling fact, which soon led to another series of novel experiments.

If the varieties produced by cold could be compared with these produced by heat, one is struck by the fact that the products in the way of marking and coloring move in lines of opposition. If, for instance, a certain color increases with cold, it decreases with heat. The conclusion was therefore reached that cold operates *as such*, and that the operation of heat is likewise specific. This conception seems to be as old as the temperature experiments themselves.

But to my intense surprise I was enabled to make the observation in the summer of 1894, that an experiment with heat made on Vanessa antiopa L. at a temperature varying from + 38 deg. to + 42 deg. C. resulted, not in the expected *heat variety*, but the *cold variety* in exactly the same way *as though the pupae had been kept in ice for several weeks in the beginning.*

This unexpected phenomenon proved a turning point in the matter of understanding the nature of the production of varieties. It led me in 1894 to establish the point, that the influences of cold and also of certain gradations of heat are not *direct* and *specific*, but that they produce the changes of coloring and marking in the butterfly indirectly, and by certain *retardations* in the development of the pupa.

This retardation theory was published by me in 1895. *It represented the view that it is possible to retard in part or altogether and even to arrest entirely the development of the organism of the pupa, not only by cold but also by high degrees of heat.* This met with no approval at first. There was a tendency to demur to the idea that heat should operate *like* cold, and that it should *arrest* development. This seemed to be contrary to all previous experience, but it was soon possible to furnish additional and imperative testimony as to the validity of the position taken.

The heat experiments of 1893 have in a few cases resulted in a peculiar *aberration* in antiopa L., an aberration found in very rare instances in nature and listed as an aberration, hygiæa Hdrch.

I enlarged the scope of the experiments in 1895, and used temperatures lower than those previously employed. These had ranged from zero to + 10 deg. C., while I now went *below* zero, and subjected the pupa three times a day for one hour to a temperature ranging between — 4 deg. to — 20 deg. C. This was continued for three or four days. This new method of the intermittent application of low degrees of cold immediately opened a new and broad field; for we succeeded not only in obtaining extraordinary changes in the markings and colorings of butterflies, but also in solving many interesting and important problems. In the first place, I had expected that these modified experiments would result in markedly differentiated butterflies, so-called aberrations, and the results fully confirmed these expectations. And in this respect the most astounding fact was that by the use of low degrees of cold I produced the same aberrations of antiopa, which I had two years previously obtained by heat, namely, the above-mentioned Hygiæa, Hdrch.

While we had produced by warmth the variety Artemis Fschr., previously produced by slight cold, we were now able to produce by extreme cold (frost) the heat-aberration hygiæa Hdrch.

Since, therefore, cold and heat in both cases produced *like* forms, the fact was established that there is no reason for attributing specific or direct operation to either of these areas of temperature, so far as the two forms of antiopa, namely, Artemis Fschr. and hygiæa Hdrch. were concerned. And since other varieties of vanessa had resulted in analogous aberrations by frost* the conclusion seemed inevitable that these variations are not *specific* and *immediate* results of the influence of extreme cold (— 4 deg. to — 20 deg. C.), but indirect results from arrested development due to this temperature, and that this arrested development is produced not only by extreme cold, but also by extreme heat, and that consequently it must be possible to produce not only the aberration hygiæa Hdrch., but all other frost aberrations by extreme heat.

This deduction was fully verified in both points both by my own investigations and by those of Standfuss. It proved possible to produce all frost aberrations by heat temperatures ranging from + 38 deg. to + 46 deg. C., but Standfuss actually observed that the pupæ exposed to heat and those exposed to cold actually hatched later by an equal period than pupæ of exactly the same age, which were maintained at normal temperatures, and that consequently both heat and cold arrested the development of the pupæ equally!

The opinion I have previously expressed of equality of arrested development both by heat and by cold has, therefore, now come to universal acceptation.

It is different with reference to the attitude to be assumed toward varieties produced by moderate cold (0 deg. to + 10 deg. C.) that the condition of things with these is similar to that just proven for aberration as shown by the production of Artemis Fschr. (as before mentioned), which belongs to these cold varieties. This I produced by heat in 1894 at about + 40 deg. C. But this observation remained as a solitary instance devoid of corroboration, and hence the old theory of the specific operation of moderate cold not only remained in force, but was also confirmed by various cold and heat experiments made in latter years by investigators of butterfly life, and further by a study of those varieties and localized forms which have northern and southern habitats. The investigations of Standfuss were chiefly instrumental in this. Basing upon his experiments he formulated the theory that varieties produced by cold must be, in a way entirely opposite to the course of aberrancy, a direct and immediate product of the temperatures causing them; since a cold variety had never been produced by heat, or *vice versa.*

I had always doubted the correctness of this theory, since my observations in the year 1894 seemed to me to prove the opposite. It seemed imperative to me, therefore, to follow up this solitary instance and to investigate every obtainable form of Vanessa experimentally with a view to finding whether or not it would be possible to produce all the cold varieties by exposure of the pupa to certain degrees of heat, as had already been demonstrated in the case of antiopa artemis.

And it was a success! It was demonstrated that about + 38 deg. to + 41 deg. C. is the most favorable temperature; that there must be but slight moisture; that exposure must be rather long and uninterrupted, as in the cases of moderate cold. And these experiments also proved that there was arrested development from both extremes, since the pupæ exposed to heat as well as those exposed to cold were late in casting their shell.

It may be of interest to give a schematic summary of the various temperatures and the results produced by them in varieties and aberrations.*

The introduction of but two forms with their varieties and aberrations into the tabulated statement will suffice to show the general outlines of the results obtained. The following can be read from the tabulation:

If pupæ of the normal form A be placed in a moderately cold temperature of 0 deg. to + 10 deg. C. from three to six weeks, during which time there are naturally excessive values of moisture, the result will be variety B, which corresponds to the northern form, or the "winter generation," or that of the glacial epoch. If the pupæ be exposed to a temperature slightly supranormal (about + 35 deg. C.) we obtain the variation C, a form now found in southern areas, or to be found there later as a climatic form. If we use somewhat extreme temperatures, and cool a series of pupæ at — 4 deg. to — 20 deg. C. three times daily for one hour each time and repeat this on two or three successive days, the result will be an aberration decidedly deviating from the normal type (Aberration D_1). This same aberration we also obtain if the pupæ be exposed to a temperature of + 42 deg. to + 46 deg. C. (Series D_2), and in the same way the cold variety (B_1) can be reproduced (B_2) by exposing the pupæ to less extreme heat, + 38 deg. to + 41 deg. C., with less moisture and more continuous exposure.

The varieties B_1 and aberration D_1 produced by subnormal temperatures can also be called into being (Series B_2 and D_2) by heat and only the slightly supranormal product + 35 deg. (eventually up to + 40 deg. C.) has its own peculiarity of form (Series C) attained by no other temperatures.

B and D are therefore indirect products modified by *arrested* development, and C = forms are *direct* and *specific* products of the temperatures calling them into being by *acceleration* of evolution.

The elaboration of these temperature experiments therefore fully confirmed the theory I had published eight years ago. They likewise explode as erroneous the theory of specific operations of sub-normal temperatures held for fifty years. Of all the results obtained, that involving the production of the variety polaris was the most striking. This butterfly, found hitherto in the *polar regions only*, and produced thus far by a cold temperature of + 5 deg. C., was actually created by a temperature of about + 40 deg. C., and indeed in a form much nearer the real polaris than those produced at lower temperatures.

But other peculiarities will be noted by a comparison of the different forms.

As before mentioned, the B and C forms move in opposite directions. If a certain color increase in one series, it decreases in the other, when compared with the normal form of urticæ. These appearances also recur between the B and D, for instance, a moderate degree of cold produces a definite form, Artemis Fschr. Then an increase of cold does not produce this artemis in more marked form, as one might expect, but the production lapses as soon as a certain number of degrees below zero has been reached into the exact opposite; that is to say, a color, for instance, black or blue, which under moderate cold expanded now diminishes and disappears entirely.

But this strange fact does not only appear in a quantitative change of pigment, but also in a very definite direction for the expansion of the black pigment. For if a specimen has a black spot, then moderate cold will extend this black spot lengthwise, while frost will expand it breadthwise, and finally excessive changes can result in such a superabundance of the black pigment that the entire butterfly turns black—a form obtained by heat in aberration extrema Fschr.

These latter parts are an experimental confirmation of the change in markings of certain groups of animals demonstrated by Eimer; but his theory of the lengthening of the stripe as being the oldest and atavistic marking is hardly tenable according to our results.

His theory, however, receives at least in part a form of support by our results. The change of color markings took place in all the forms D, not in any kind of irregularity beginning here or there, but in regular direction from below upward, or from the back to the front, i. e., the lower side of all wings was changed before the upper, and the back wing before the front wing. When I raised aberration in form D by heat and not by frost, this order was changed. The changes took place in the direction from above down, and from front to back.

This exception to the rule is not a solitary instance; many of them could be named. Eimer himself admitted a large number of exceptions, so that he was not ready to speak of a general rule, much less of a law. But exceptions mentioned above became important in that they are an explanation of the aberrations of butterflies which occur in nature at rare intervals.

The heat experiments were not only so arranged that I could place the pupæ into an incubator, but I could also expose a great many of them in midsummer several hours to the direct rays of the sun by means of insolators. The result was in so far of exceeding interest that both those pupæ exposed in the sun and those in the incubator resulted in like aberrations. And since these coincided with such cases as are always found in nature, the conclusion was a legitimate one, *that instances occurring with great rarity in nature as curiositics for that reason, unintelligibly mysterious lusus naturae in the way of aberrations result from the fact that young pupae are accidentally exposed to the direct rays of the sun several, i. e., three, four or ten hours.* My measurements showed that under these circumstances the bodily temperature of the pupæ rises to + 38 deg. and even to 40 deg. and 43 deg. C. and more.*

Rather more rarely it may occur that such aberrations are the result of the fact that pupæ which have been exposed to frost or hoar frost in the early fall nights, or even to the lower temperatures of fall weather,† or to a touch of winter cold, result in the spring in similar aberrations, as some few cases seem to prove.

The next question that arises is how are we to understand these various facts? What is their essential nature?

As far as the Series B and C are concerned, the answer is a simple one: These are varieties such as exist in the present earth epoch, as northern and southern varieties; such as polaris Stgr., ichnusa Bon, erythromelas Aust., and epione Fschr. These varieties and family forms wherever their flying areas touch pass through slight gradations from one form into the other. Therefore, we understand that Series B and C as such are similar to those changes which are gradually produced by a change of climate or a change of habitat.

The nature of Series D and its frost and heat aberrations is more difficult of interpretation.

Eimer conceives of the facts which I have obtained and which he mentions in his "Orthogenesis der Schmetterlinge" repeatedly, as forms which are changed by spasmodic leaps and highly developed. In general I am of the same opinion, and consider them as appearances which in the further development of our earth may be produced; yea, in part are sure to be produced! An entirely different conception is represented by Standfuss, who considers these aberrations new and purely individual deviations which have nothing in common with the physiographic development of the species, and therefore really never existed as a permanent form, and never will exist as such, but will always lie outside the track of evolution as singular anomalies.

I cannot admit this proposition which it would be difficult to form and which has led some to consider these aberrations as pathologically conditioned. I shall adduce my confirmations in the Allgemeine Zeitschrift für Entomologie,‡ where all of the experiments, investigations and theoretical deductions, which are here only briefly cited, will be elaborated in detail and with plates. In the same way experiments with other varieties and investigations belonging thereto in reference to the problem of inheritance, subject to the principle of Lamarck, cannot be reported until the richly illustrated original article in the above periodical shall have been completed.

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* Analogous changes specifically show in the gradual obliteration of the light spot on the forward edge of the upper wing by the peripheral expansion of the black pigment, while on the other hand the dark spot in the central area (or in whatever area it may occupy in the normal forms) is gradually displaced (a compensatory relation of color!)

* These high degrees of temperature are not necessary if the exposure lasts eight or ten hours. The form D_2 can be produced at + 38 deg. and even at + 36 deg. as I have shown in 1898.

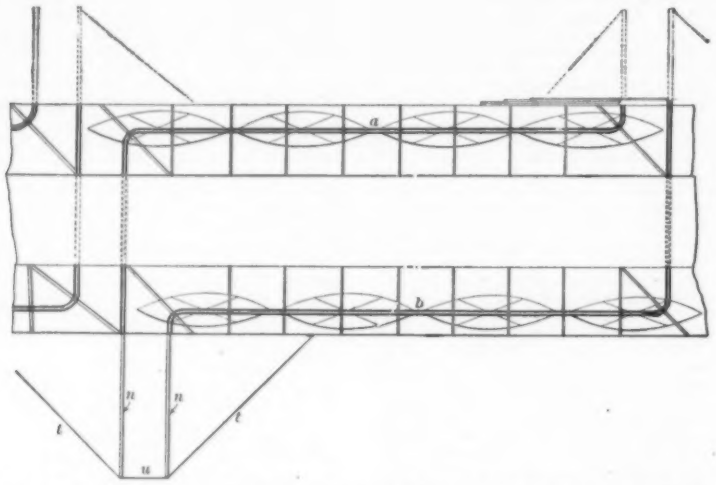
† These aberrations result from slight cold (0 deg. up to + 2 deg. and + 3 deg. C.) if the exposure lasts several days.

‡ Published by Neumann of Neudamm.

*	D_1	B_1	A	C	B_2	D_2
	Frost Aberration. (—4° to —20° C.)	Cold Variety. (0° to + 10° C.)	Normal Form. (+ 20° C.)	Heat Variety. (+35° to + 40° C.)	Heat Variety. (+38° to + 41° C.)	Heat Aberration. (+ 42° to + 46° C.
	Ichnusoides Selys. Hygiaea Hdrch.	Polaris Stgr. Artemis Fschr.	Urticae L. Antiopa L.	Ichnusa Bon. Epione Fschr.	Polaris Stgr. Artemis Fschr.	Ichnusoides Selys. Hygiaea Hdrch.

THE PETERSON BOAT-LAUNCHING APPARATUS.

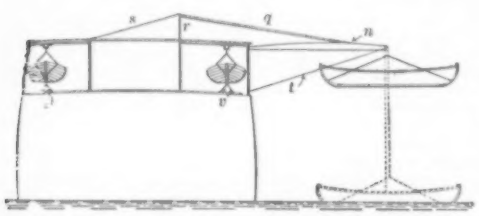
In recent years very few inventions have been made in appliances for launching boats from shipboard, whereas numerous and excellent ideas have been developed in improved lifeboats, rafts, self-detaching hooks, life preservers in different shapes, etc. However, no ship, no matter how well constructed, engined and manned is proof against accident, and no one knows at what time the ship must be abandoned, and the only means of rescue will be the lifeboats.



DECK PLAN OF SHIP WITH PETERSON BOAT-LAUNCHING APPARATUS.

Admitting the great value of good lifeboats and other appurtenances pertaining to means of life saving, the fact remains that unless the vessel is fitted with an apparatus by means of which the boats can be easily launched under any existing circumstances, the safety of the lives entrusted to the ship is not assured.

Of the many improved boat davits, the most prominent is the Mallory davit, which to a great extent is being adopted both in merchant and naval vessels as superior to the old-style swinging davits. Unfortunately even the best system of davits now in use does not fulfill the requirements, as too much labor is generally involved in manipulating it and there is too much



SECTION OF SHIP WITH LAUNCHING APPARATUS.

uncertainty as to its proper working in case of emergency.

Following are the most important requirements for an efficient boat-launching device:

1. The apparatus must be so constructed that it can be worked by manual power with great ease. To depend upon steam or other artificial power is objectionable, as this may not be available when most needed.

2. Boats should be so located that passengers and crew can easily get into them. Stowing of boats inside each other or bottom up, as is sometimes the case, is absolutely condemnable.

3. Boat-launching apparatus should preferably be so constructed that any boat can be launched from either side of the vessel.

4. Boats must be well clear of the vessel when they reach the water so that oars can be used on both sides of the boats.

5. The lowering of the boats should not be performed from the ship. The launching system should be such that the boats can be conveyed from the ship to the water by the boat crew.

6. As it is of the greatest importance to minimize the labor involved in getting the boats from their stowed position into the water, the releasing appliances must be as simple as possible and boat cradles should preferably be avoided. Also boats in their stowed position should be connected with the conveying apparatus, so that they can be launched at a moment's notice.

The Peterson launching apparatus has been constructed to meet these severe requirements and care has been taken to make it with as few parts as possible.

The new system comprises two permanent overhead tracks, each having a terminus on both sides of the vessel, and four booms of built-up section forming a continuation of the tracks, when swung in position ready for use. The number of boats to be stowed on each track has to be determined by the total number carried, but it is not advisable that more than four boats should be carried on one track. In the stowed position the boats are suspended from the tracks, and kept in equilibrium by rope lashings through the keel and eyebolts on deck. Trip hooks can be used, but rope lashing is safer, as a knife, which is always handy, will release the boat in less time than a trip hook.

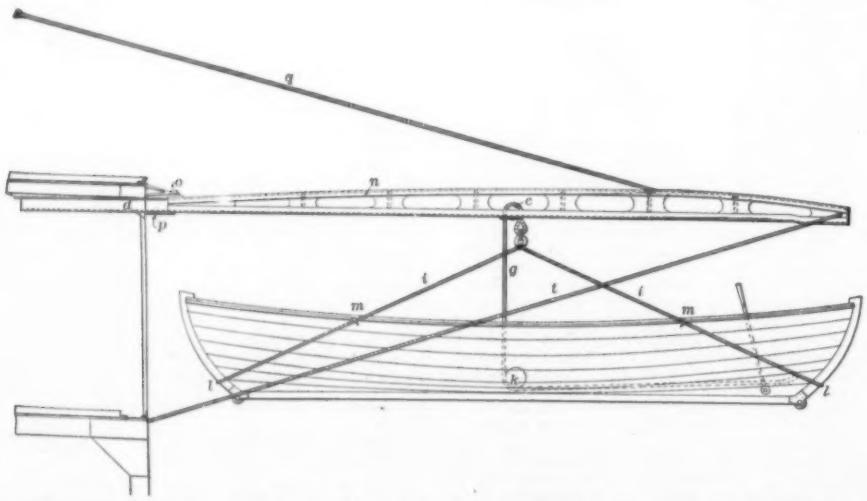
The permanent tracks are made of two Z bars riveted to the overhead structure. The lower flanges of these Z bars form a guide for truck, *C*, the conveying medium for the boats. To this truck the boats are connected by two stout hemp ropes of sufficient strength passing over sheaves which are mounted on the same pin as the rollers. One end of the hemp ropes is attached to a hanger, *i*, embracing the boat and thus giving four points of support, instead of two as used in the present system, and adding to the stability. The other part of the ropes passes over a leader near the center of the boat, to a friction brake at the stern, which holds this end of the rope firmly, and when boats are to be lowered this is done by operating a lever which releases the grip on the ropes.

The second part of the launching apparatus, the booms, are pivoted at the terminus of the track and carried partly by straps, *p*, on the permanent track, and partly by the stay or stays, *q*.

Spans and guys, *u* and *t*, serve to keep the booms in position. When not in use these are folded up against the ship's side. To put the booms in position ready for launching, and releasing the boats by cutting the lashing ropes, will not require as much time as accommodating the passengers in the boats. When this latter part is done the boats are pushed along on the tracks and out to the end of the booms, from whence they are lowered from the boat itself by the use of above mentioned friction brake, controlled by one of the crew detailed for this duty.

The booms and stays are designed to safely carry the weight and are made long enough to allow the boats to clear the ship's side.

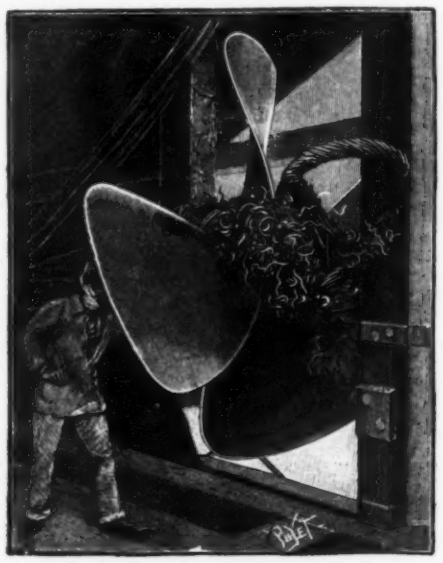
By this system the boats can be launched from either side of the vessel, as the tracks extend across from side to side. For the safe conveyance of the boats over the deck, rollers are applied at the junction of the keel and stem and stern. When the boats are lowered the free end of the lowering rope passes over the sheave and drops into the water, leaving the trucks on the boom. A recess on the outer end of the boom—which is closed—prevents the truck from rolling back. When the boat reaches the water the weight is taken off the hanger, and as this is simply laid in slots cut in the stem and stern, and guided by open eyebolts, *m*, it can be easily removed.



BOAT SLING AND BOOM OF NEW APPARATUS FOR LAUNCHING BOATS.

THE FOULING OF SCREWS BY CABLES.

Whoever has witnessed the casting off of the cables that secure a modern steamship to a wharf by her stern, knows the care that has to be taken to quickly haul in such cables, which almost always belong to the vessel, and have to be coiled up on deck until another landing is made. The haste that is made in performing this operation is not due to the fact that there is any fear of letting the cables get wet, but merely to the fact that in the different maneuvers, the cables, under the influence of currents, etc., might come into contact with the screw. With the old paddle wheels, the danger was not so great, since they were situated amidships, and consequently far from the point at which the cables dropped when they were cast overboard. The case is exactly opposite with the screw, which has a sort of corkscrew motion, and, when one of its blades happens to strike the cable, there are many chances that the latter, if it is not broken by the impact, will be carried along in the rotary motion and wind around the boss of the screw in an inextricable manner. In such a case, one of two things may occur: Either the blade of the screw or the screw itself may be broken under the stress, or else, what is just as bad, the winding up of the cable may render the screw and consequently the boat immovable. Such a thing as this recently happened with the steam tug "James Leary," which met with a submarine cable (an electric one) stretched between East Greenwich and Pattowannet, Rhode Island, by the Narragansett Electric Light Company, of Providence. As soon as an abnormal resistance was perceived, the



ACCIDENT TO A SCREW.

engines were stopped; but it was too late, since the rapid rotary motion of the screw had soon wound the large copper cable several times around it and tied it in inextricable knots. The tug was rendered completely immovable, and the conductor had to be cut away and the boat towed to a dry dock.—For the above particulars and the illustration, we are indebted to La Nature.

PARSONS' SCREW-PROPELLER.

According to the experiments of Dines and others, it has been established that the normal pressure on a plane moved at small inclinations through air or water, varies approximately as the angle of inclination and the square of the velocity of motion. In a screw-propeller of the usual pitch ratio (1 to 15 pitch co-efficient) the angle of inclination of the blade to the direction of motion through the water, is approximately the same for such distances from the shaft line as lie outside about two-fifths of the radius of the propeller-circle, while the velocity of these points through the water varies approximately as the distance from the shaft. From this it follows that the pressure upon the water of any element of the blades (between the above limits) will vary approximately as the square of the distance of the element from the shaft-line. In high-speed vessels when the water pressures are great, cavitation commences first near the tips of the blades and extends toward the roots of the blades as the speed or slip ratio of the propeller is increased.

The cavitation which is found to take place around the conical end of the boss abaft the propeller is due to the rotational velocity imparted to the water in the vicinity of the boss by the normal action of the blades and also by their skin and eddy friction on the water. This rotational velocity closes in around the after cone, following the principle in hydrodynamics that the angular momentum in a vortex tends to remain constant. The angular velocity of the water around the cone is therefore much in excess of that of the propeller-cone itself.

In an invention recently patented by Charles A. Par-

sons, it is sought to reduce the cavitation which takes place at the back faces of the propeller-blades near the tips by forming the blades with a reduced pitch near their tips. The invention furthermore provides small vanes on the propeller-cone, adapted to prevent cavitation around the cone and to utilize for propulsion some of the rotational energy of the water close to the propeller-cone, which energy Mr. Parsons claims is lost with the type of propeller in ordinary use.

To obtain a high mean slip and thrust without producing serious cavitation, has been the object of many inventors; but their efforts to attain this end have been generally made in increasing the pitch of the blades toward their points. Mr. Parsons states that he has ascertained that the desired effect is produced by forming fast-running propellers with a reducing pitch toward their tips, the reduction beginning about half to two-thirds outward from the boss or blade root. Such reduction of pitch increases to about a ten per cent reduction at the blade-tips. Theoretically also it would appear first that this variation of pitch should be such that the slip ratio at any given distance from the shaft should be in inverse proportion to the square of that distance; second, that cavitation would commence simultaneously over a large area of the propeller-blade thus constructed; third, that such propellers could be run faster without producing cavitation, while at the same time effecting a greater mean slip ratio and thrust than would be possible with propellers constructed with blades of constant or increasing pitch toward their points. Mr. Parsons says that he has confirmed this by experiments on propellers constructed according to his invention which is based on this theory.

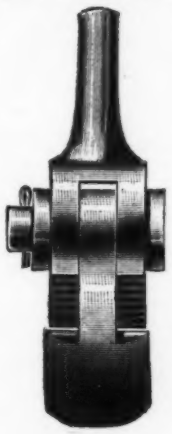


FIG. 1.

FIG. 2.

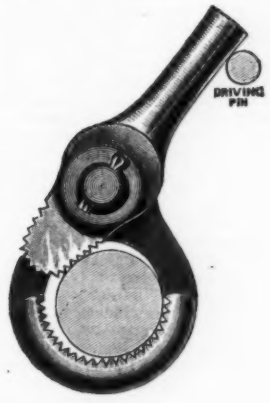


FIG. 3.

TURTON'S LATHE-CARRIER.

TURTON'S LATHE-CARRIER.

MESSRS. GEORGE TURTON, PLATTS & CO., of the Railway Buffer, Spring, and File Works, Sheffield, are now manufacturing an improved lathe-carrier which has been recently patented by them, and which we illustrate herewith. Figs. 1 and 2 show the carrier at rest; Fig. 3 shows it in actual work. This carrier is simply slipped on to the shaft which is required to be machined, and the work is then put into the lathe, with the shank of the carrier in front of the driving pin in the face-plate of the lathe. When the lathe is started, the driving pin catches the carrier, which automatically tightens itself on the work. This entirely dispenses with the loss of time which is entailed by the workmen having to tighten up screws as in other carriers. When small work in large quantities is being machined, this saving of time must amount to a considerable item. The more pressure that is applied only causes the carrier to grip tighter, and cuts have been applied which stop the lathe and throw off the belt without in any way causing the carrier to lose its hold. All the parts are made of a high class of steel, with the working parts case-hardened, so that each carrier will have a very long life if used with ordinary care.—Engineering.

COMPRESSED AIR LOCOMOTIVES.

THE Invalides station, which the Compagnie des Chemins de Fer de l'Ouest has just constructed, is designed principally for the service of the great lines of Brittany and Normandy, and, consequently for relieving the Saint-Lazare and Montparnasse stations. To do this, it has been necessary to establish a short line between the old junction that skirts the Seine and the Viroflay station a little beyond that of Versailles (left bank). At this place, the trains will reach the main line, upon which they will be able to run in all directions. The short line, of which the part comprised between the Invalides and Meudon is already under exploitation, is established wholly for electric traction. It constitutes the first railway line in France of which the trains are currently actuated by electric motors, for we cannot consider the two miles of the Compagnie d'Orleans comprised between Orsay and Austerlitz stations as an exploitation properly so-called.

The electricity is furnished by a central station situated at Issy, and the current is led by a third rail that accompanies the line for its entire length and upon which bear the contact shoes of the motor cars, in order to take up the power needed. This system offers a host of advantages that we shall not enumerate here; but it presents one drawback, and that is that it causes interruptions of the conductor at the changing and crossing of tracks. Upon the main line and at the approach to the stations, this is a matter of no great importance, since the speed acquired by the train easily permits of crossing switches without sensible retardation. But this is not the case in the switching about and making-up of trains at stations. Now, since the company, by reason of the contract made with the city, cannot employ steam locomotives in the interior of the Invalides station, it has had to look for a style of smokeless locomotive capable of performing yard services. It is with such an object in view that it has recently had constructed three compressed-air locomotives which theoretically fulfill all the conditions desired. These locomotives are designed likewise for aiding trains that happen to be momentarily in distress upon the line as a consequence of the interruption of the electric current. They have been constructed in such a way that they can make the round trip between the Invalides and Versailles stations without recharging. Compressed air, employed as a motive power, especially for street car propulsion, has not given very good results; so that, upon certain lines, it has become necessary to discard it; notwithstanding the existing installations, the efficiency was deplorable. With the locomotives of the Compagnie de l'Ouest, the conditions are no longer the same, since the engines are not intended for use on the line. They have to make long trips only exceptionally, and are of interest merely for yard service at stations. The foregoing remarks as to the inconveniences found in regular service are, therefore, not applicable to them.

The compressed air necessary for these locomotives is produced by a small plant installed below the Esplanade des Invalides, at the level of the subterranean tracks of the new station. This plant consists of three independent groups each formed of a synchronous triphase current electric motor, which receives a 5,000-volt current from the central station at Issy, and of a Mekarski vertical air compressor of 200 horse power, making 100 revolutions a minute, and raising to a pressure of 1,422 pounds to the square inch the air that the Compagnie de l'Ouest purchases from the Compagnie Parisienne d'Air Comprimé at a pressure of 85 pounds to the square inch. Each compressor consists of four cylinders mounted in pairs in tandem, so that the same connecting rod serves for actuating the two pistons of the same group. The two cylinders of each of these two groups do not have the same duty to perform. The upper one effects the compression of the air only in the portion situated above the piston, while the lower one acts only for that of the part comprised beneath its piston. From the viewpoint of work, then, the two cylinders of a tandem may be considered as one and the same cylinder. Let us see how the compression is effected: The lower cylinder draws in the air at 85 pounds to the square inch and compresses it to an intermediate pressure and then sends it into a reservoir, whence it is sucked by the upper cylinder in which the compression is carried to 1,422 pounds to the square inch. In order to prevent heating of the metal, the cylinders are surrounded with jackets within which circulates a current of cold water. On another hand, water is allowed to flow likewise in the interior of the cylinders, so that the air coming from the compressor is always accompanied with humidity and must be dried before it is used. The air thus compressed is stored up in an accumulator composed of six groups of 20 reservoirs. The locomotives, according to their requirements, come to these latter to obtain their supply of pneumatic power. The adoption of a system of compressed air accumulators such as those above described was indispensable, since, as we have seen, the plant is supplied by the electro-motive power of the line, and, as the locomotives are partly designed for the relief of the electric trains in cases of an arrest of current, it follows that the plant could not operate in cases of distress and would be unable to render the services for which it was installed if it were desired to employ recently compressed air.

Each of these three groups of compressors is capable of giving 4,400 pounds of air under pressure. Let us add that the plant is arranged in such a way that it can furnish special portable boilers designed for reheating the compressed air upon the locomotives.

These locomotives are carried by two two-axled bogies. They have the form of a baggage car, provided with two cabs, one at each end, for the engineer. This arrangement does away with the necessity of turning the engine around for running in the opposite direction. The entire mechanism, which is extremely simple, is situated under the body of the engine so that it can be easily inspected, cleaned and repaired when need be.

The main part of the locomotive contains 33 reservoirs of compressed air, which the engineer can connect with the cylinders of the motors from either cab. The motors are two in number, and situated near each of the cabs. The air passes into an intermediate reservoir before entering the motors, each of which is provided with two cylinders placed outside of the frame of the car. The first is a high pressure one of 284 pounds to the square inch, and the second a low pressure one of 143 pounds. At its two extremities, the engine is provided with special arrangements for the charging of the compressed air. It carries likewise portable steam boilers for the heating of the air.

The engineer's cabs are provided with all the apparatus necessary for operating and controlling the different parts.—For the above details and the cut we are indebted to La Nature.

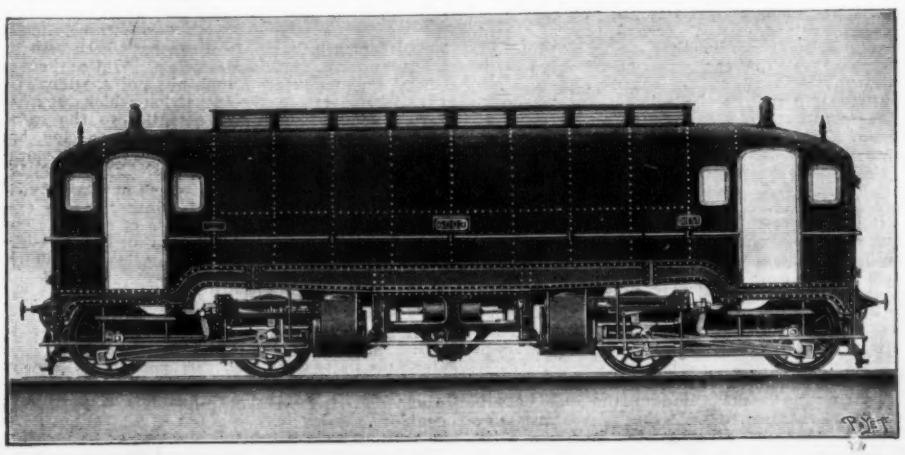
SAFETY APPLIANCES.*

THE act of 1893, with its amendments, known as the safety-appliance law, became of full effect on the 1st of August, 1900, and the beneficent results of its operation are now being realized. The greatly increased security of life and limb with which the men on freight trains and in freight yards now perform their work is apparent on every hand. Evidence of the improved conditions that have resulted from the practically universal use of automatic couplers on freight cars appears in the accident records of the commission, of the railroad companies and of the railroad employés' insurance organizations, and also in the testimony of railroad officers and employés and the heads of the engineers', conductors', firemen's and trainmen's brotherhoods.

This gratifying state of affairs is due to the Federal statute, to the railroad companies' united action, and, we believe we may fairly say, to the efficient performance of their duties by the inspectors in the service of the commission; in other words, to the energy and perseverance of the men, in and out of Congress, who brought about the passage of the law, to the persistent work of the managers and mechanical officers of the railroads, who, in their technical associations, carried through the various measures necessary to accomplish uniformity, and to the intelligent and careful inspection by which the commission has been able to promote the efficient and methodical maintenance of couplers, brakes, and handholds on freight cars, and to facilitate the adoption of good practice in regard thereto.

In the expansion of traffic incident to unprecedented activity in manufacturing and commerce, many railroad companies found themselves hard pressed to keep pace with the demands for increased locomotive power, cars of greater carrying capacity and other costly facilities, and thus, almost of necessity, gave inadequate attention to some matters of detail. In this emergency the usefulness of the commission's inspectors, in supervising the methods of dealing with defective cars or with doubtful questions about the requirements of the statute, has not only been evident in resulting improvements, but has been cordially recognized by railroad officers of all grades. These inspectors, who are competent men of long experience in car and train work, have not confined their observations exclusively to those details of construction and operation which are specifically covered by the statute, but have taken notice of all features of operation, maintenance and repairs which seem to be germane to the work in which they are engaged. In their interviews with railroad presidents and managers they have frequently made suggestions, based on their observations, which have elicited much commendation from those officials.

* Extracts from fifteenth annual Report of the Interstate Commerce Commission.



A COMPRESSED AIR LOCOMOTIVE OF THE COMPAGNIE DES CHEMINS DE FER DE L'OUEST.

The number of conductors, brakemen, switchmen, flagmen and watchmen, killed in coupling accidents in the year ending June 30, 1901, expressed by the ratio of the number killed to the total number employed, appears to have been less than in the year immediately preceding by about 35 per cent, and the number injured by about 52 per cent. This appears in the following table, which covers 70 per cent of the operated mileage of the country:

TABLE NO. 1.—ACCIDENTS INCURRED IN COUPLING AND UNCOUPLING CARS.

Year ending June 30.	Employés on 87 roads—		Number of trainmen* employed to one—	
	Killed.	Injured.	Killed.	Injured.
1898	209	5,433	555	21
1899	196	5,281	592	22
1900	228	3,970	546	31
1901	161	2,082	837	65

* Ratio based on trainmen other than enginemen and firemen, and including switchmen, flagmen, and watchmen.

Deaths and injuries caused by falling from trains and engines have long been a marked feature of railroad-accident records, and the deplorably large totals under this head have been the subject of comment in the reports of the commission for former years. The following table shows the totals under this head:

TABLE NO. 2.—ACCIDENTS CAUSED BY FALLING FROM TRAINS AND ENGINES.

Year ending June 30.	Total number of employés—		Number of trainmen* employed to one—	
	Killed.	Injured.	Killed.	Injured.
1893	644	3,780	354	60
1897	408	3,627	497	59
1898	473	3,859	480	57
1899	450	3,970	390	45
1900	529	4,435	861	43

* Number of trainmen includes enginemen, firemen, conductors, and other trainmen.

It will be observed that there is a material increase in the ratio of killed in 1900 over the three years next preceding. The various causes of this increase can only be conjectured, but among them are obviously the increase in the number of inexperienced men employed, and the increased amount of work done by the men when the volume of traffic is constantly increasing, as was the case on many of the railroads during the year under consideration. The use of air brakes on freight trains is confidently expected to lessen the deaths and injuries under this head; but air brakes were not nearly so generally used in 1899-1900 as they are now. On the other hand, it is well known that, with the more powerful locomotives, heavier cars and longer freight trains which have come into general use during the past few years, the use of air brakes on these trains has been the occasion if not the cause in some circumstances, of an increased number of violent shocks, which of course tend to increase the danger to men on the cars. The increase in the dangers due to the practice of running longer trains is not to be measured alone by the increased proportion of powerful locomotives in use, for two engines on the same train, on level lines as well as on steep grades, are now very common.

A suit for damages for personal injury has recently been decided by the State court of Illinois in which the safety-appliance act was a factor in determining the liability of a railroad company. The case is known as Hood v. T. H. & I. R. R. Co. The facts showed that the plaintiff, a freight brakeman, while coupling cars on a dark night, slipped and fell under one of the cars and received serious injuries. He established to the satisfaction of the jury that the car which crushed his hand was not equipped with grab irons, as required by the act of Congress. Without the benefit of that act he could not have recovered, as the injury would have been held to be one of the risks incident to his employment. The Appellate Court of Illinois held, first, that to bring such a case within the operation of the act of Congress it was not necessary to show that the car contained goods constituting an interstate shipment. It was sufficient in that respect to show that the car in question was a part of a train engaged in interstate commerce, and that the car was attached to the train at East St. Louis, Ill., and billed through to Indianapolis, Ind., and that it was not provided with handholds as required by law. Second, the court held that it made no difference whether the employé did or did not know that the car was not provided with handholds, as section 8 of the act of Congress expressly relieved him from the common-law rule concerning the assumption of knowledge of the risks of employment.

In this case the Appellate Court affirmed the judgment of the trial court, which held the company liable. The State Court upheld and enforced the Federal statute and gave it that liberal interpretation which prevails in the interpretation of remedial statutes.

As this is perhaps the first case in which sections 4 and 8 of the act have come before an Appellate Court, the decision as a precedent is important to all concerned; and it is gratifying to those who are interested in the protection of life and limb in the railway service that the validity of the act of Congress has been sustained on all the points raised, and by a unanimous court.

Another case, which, if sustained, will have an important bearing upon the value of the safety-appliance law to railroad employés is that of White v. The Chicago Great Western Railway Company, recently decided by the United States circuit court for the southern district of Iowa, which reached that court on a removal from the State court.

The case involved the application and construction of a statute of Iowa, one section of which is quite similar to the second section of the Federal statute under discussion. Each statute prohibits the use of any car not equipped with automatic couplers so they may be coupled or uncoupled without the necessity of a trainman going between the cars. The plaintiff, White, was injured while attempting to make a coupling between a car that was properly equipped, in accordance with the provisions of both the State and Federal law, and the tender of an engine that was not provided with automatic appliances, which necessitated the use of the old link and pin. The United States Circuit Court instructed the jury to return a verdict for the railroad company, on the ground that a locomotive tender was not a car within the meaning of the act.

As the State and Federal acts are substantially similar, that court would undoubtedly construe the Federal statute as not broad enough to require the locomotive and tender to be equipped with safety couplers. If that construction shall be upheld by the Supreme Court, the safety appliance act will be considerably impaired in its practical value. It is, therefore, recommended that section 2 of the act be amended so as to specifically include locomotives and tenders. Such an amendment is necessary to put the statute in accord with the approved practice of all the prominent railroads. The reports from the roads to this commission show that railroad officials, recognizing the need of uniformity in couplers throughout the whole length of a train, or a series of trains, have made good progress in equipping their locomotives and tenders with automatic couplers, and have so far equipped more than 75 per cent of them with such couplers. While this action is highly commendable, it is still desirable to add this reasonable and useful amendment to the law, if for no other reason than to insure uniformity among all of the roads.

One of the greatest obstacles in the way of safety in freight-train operations at the present time is the presence, in nearly all trains, of old and weak cars. In the unavoidable shocks incident to the movement of heavy (new) cars at the increased speed now found necessary, these weak cars are often damaged and sometimes completely crushed, thus endangering the lives of the trainmen. The use of automatic power brakes on freight cars, being still to a considerable extent a device about which enginemen, repairmen and others have yet something to learn, is naturally the frequent cause of severe shocks in trains. No one better understands the dangers connected with cars of inadequate strength and stiffness, or more sincerely regrets the present conditions, than do the managers of the railroads; yet the only remedy which appears to be feasible—the abandonment and destruction of the old cars—is one which must be applied gradually. The use of cars of greater tonnage capacity is now universally deemed essential in order to carry freight economically. Practically all of the thousands of new cars built during the past year have been designed to carry from 30 to 55 tons. These cars weigh empty from 15 to 19 tons each, whereas the older cars weigh from a fourth to a third less. The increased economy secured by the use of the heavy cars is so marked in some kinds of traffic that prudence dictates the abandonment of smaller cars long before they are worn out, and to some extent this has been done. Yet the lighter cars are still sufficient in many kinds of traffic; while to provide for the expansion of business on most of the roads during the past two years any available car, economical or uneconomical, has been pressed into service. Under these circumstances the use of strong and weak cars in the same train has been looked upon as a necessity. It seems reasonable to expect that every well-managed railroad will do away with this element of danger as fast as is practicable, and therefore no recommendation is made on the subject at this time.

The commission employs six inspectors. These men visit the freight yards, examining all cars with a view of discovering any defects which may constitute a violation of the Federal statute. As before stated, these inspectors are men who have had long experience in matters of railway equipment. An inspector always, when possible, introduces himself to the officials in charge of a yard or station which he visits. The rules under which the inspectors act were compiled after extended conferences with master car builders, chief car inspectors and other railroad officers, and with the heads of the brotherhoods of railroad employés. Before final adoption (on April 1, 1901), they were sent out for criticism and approval to a large number of railroad officers of the classes named. In their final form the rules have proved suitable and satisfactory. They have enabled the inspectors to inform the commission concerning the actual state of affairs as regards observance of the law, while at the same time they have not caused friction with the railroad men or dissatisfaction on their part. At the request of the Master Car Builders' Association about 30,000 copies in pamphlet form have been sent by the commission to railroad officials. While these rules embrace many points which are not specifically dealt with in the statute, the inspection which they call for covers details which are essential to the safety of those for whose benefit the law was enacted, and, as noted above, the rules have met with general approval.

In addition to the matters which are specified in the statute, the rules require the inspectors to examine the ladders on the sides and ends of cars, the steps at the sides and ends and the running boards which extend along the roof. The suggestions which the inspectors have been able to make concerning these details have been received by railroad officers in good spirit, and it is believed that they are generally in such satisfactory condition that no statutory regulation concerning them is necessary.

It is a well-known fact that uncoupling attachments have been one of the most troublesome questions in connection with the introduction of vertical plane couplers. A large percentage of the minor accidents to trainmen since the introduction of automatic couplers has occurred while using or trying to use these appliances. The horizontal rod, bent at the end to form a handle, is frequently knocked out of position by some slight accident, or is out of order for some cause or other, and the brakeman attempting to use it finds difficulty in moving it. This often or usually happens while the car is in motion, so that the man has to run alongside of the train; and any unexpected delay or difficulty naturally draws his attention away from the ground and his footing and thus leads him almost unconsciously to neglect his own safety. Many uncoupling rods or hooks are found defective by reason of too short a chain. This defect is liable to cause uncoupling of the cars when they are in motion, and this, on an ascending grade, and particularly in passing over a summit, has many times been followed by a collision. This danger being realized, the inspector or shopman who sets out to remedy the defect of a short chain is liable to put on a chain which is too long, thereby introducing a difficulty of another kind; for too long a chain may make it impossible for the brakeman or switchman to lift the coupling pin without going between the cars. As we have already intimated, this and other difficulties with uncoupling apparatus are, it is believed, in a fair way to receive early attention and correction.

A common defect in couplers, and one which is the cause of much trouble and expense to the railroads, is breakage of the knuckle. And, as is well known, these breakages are often due to shocks or strains which, if the knuckle had been solid, would not have been serious enough to produce injury. In other words, if it were not for the slot and holes which are left in the knuckles for the purpose of making it possible to couple to another car with the old-fashioned link and pin, the strength and security of the knuckle, and therefore of the coupler as a whole, would be much greater than it is. These weakening features of the coupler were, in the transition period incident to the gradual change from the link-and-pin to vertical-plane couplers, a necessity; but as the transition period is now passed, the necessity no longer exists, and there is no good reason why solid knuckles should not be generally introduced.

Railroad officers have complained a good deal of rough handling of cars in yards. With the general use of automatic couplers, relieving the men of the necessity of going between cars which are about to come together, it has become possible to quicken the work of switching by moving the cars much faster than formerly and taking less care to properly graduate the speed of one car or a draft of cars as it approaches another. This complaint is, no doubt, well founded. The condition is regrettable, not only because of the damage inflicted on cars and their contents by this rough handling, but also because it introduces a positive element of danger. The injuries which may be done to a car in such case may or may not be discovered at the time. If the breakage of a timber or loosening of a bolt or other fastening occurs in a yard and is not noticed and remedied at the time, it constitutes a serious element of danger throughout every mile which that car may run until the defect is discovered, and it may be discovered only when it causes a derailment while running on the road at high speed, causing thousands of dollars damage. It is needless to say that the remedy for this fault is in the hands of the railroad superintendents themselves and lies chiefly or wholly in the discipline of the men handling the cars.

The inspectors have noted a harmful practice in connection with air-brake hose, which, unfortunately, seems to be on the increase—the practice of pulling one car away from another without disconnecting the hose couplings, thus leaving these couplings to separate automatically. This separation is theoretically provided for in the design of the couplings, and is intended to take place without damage to the couplings or the hose; but practically the hose is strained and frequently loosened at its fastenings, so that defects are produced which are allowed, perhaps in some cases unavoidably, to go a shorter or longer time without repairing. This of course introduces an element of constant danger while trains are running, for the accidental rupture or parting of a hose or its connections while a train is in motion is sure to result in a sudden stoppage of the train; and a sudden stoppage, with the car couplings in their present condition, is quite liable to cause such shocks as to derail, damage and crush one or more cars. In trains of which only a part of the cars are equipped with air brakes in use it often happens that a stoppage of this kind will result in hundreds of dollars' damage to the unbraked cars in the rear of the train, and consequent danger to the trainmen. Injuries to trainmen from this cause have been somewhat common, and some of the injuries have been fatal.

The practice of thus allowing hose to be pulled apart by the locomotive is perhaps partly due to the feeling of the men that they ought, when possible, to avoid going under cars to uncouple the hose. This is a reason which should not escape consideration, yet it must be borne in mind that in thus avoiding one danger a worse one may be caused. Therefore, in the freight service, as in the passenger, it is the duty of officers, trainmen, and all concerned to support and promote such regulations and discipline as will make it safe for the men at all proper times to perform the necessary duties under and between the cars.

It will be observed that one of the prominent matters which has engaged the attention of the inspectors is the condition of retaining valves. The retaining valve partially controls air pressure in the brake cylinder, and is opened or shut by a handle at the roof of the car, where it is within convenient reach of the trainmen; it is a device for more efficiently and safely controlling the speed of trains on steep descending grades. While, under favorable conditions, the air brake is efficient without this auxiliary, its use is a valuable additional safeguard, and on very steep grades it is a necessity. It appears, however, that but few railroads have as yet made regular, intelligent and systematic use of retaining valves, and as a result the valves have been very generally neglected. Trainmen do not use them in all cases where they should, and often they are unable to use them if they would, because they are not in working order.

The systematic maintenance of air brakes on freight cars requires the intelligent co-operation of all the men who have to do with the making up, movement and distribution of trains. Every conductor should

promptly advise the repair men of all defects found in service, to the end that these shall be repaired in the shortest possible time. The brakemen (who, it is gratifying to observe, are being carefully instructed by many of the roads in the theory and operation of the air brake) should keep their conductor fully advised of the conditions throughout the train. Brakemen can easily detect many irregularities which the inspectors at the yards can discover only by great care and the expenditure of much time. Whenever the air brakes on a car are cut out, the reason for so doing should be recorded on a card to be attached to the car.

The running of trains partially air braked is a practice which is still tolerated everywhere. To an extent this impairs the value of the air brake as a safety appliance, for an automatic application of the brakes on a moving train, in consequence of the accidental rupture of a hose or breakage of a pipe—and the provision for automatic application in these circumstances is an essential element in any train brake—checks the speed of the air-braked cars so very quickly that the unbraked cars, behind those braked, are by their momentum crowded against those in front with such force as often to crush and sometimes to derail one or more cars. The balance of economy is, probably, in favor of the running of trains partly air-braked, rather than with no air brakes, in spite of the losses due to this cause; but the duty of doing away with such a dangerous condition must, nevertheless, be obvious to every railroad manager.

PSYCHOLOGY.*

By Prof. E. A. PACE.

To define *a priori* the nature and scope of a science is always difficult; and it is especially difficult during periods of transition. Speculation as to what psychology ought to be is of course interesting and important; but its value depends largely upon the frank recognition of what psychology actually is, or perhaps what the psychologies actually are. Even the statement that psychology is the "science of mental processes," owes much to its elasticity; for the psychologists who accept it differ as to the meaning of the terms "mental" and "process." They differ more widely as to the worth of particular methods and hypotheses; and they are by no means unanimous regarding generalizations and laws.

This situation is due in part to the fact that psychology, on taking its place in the midst of the empirical sciences, found that these, by their rapid accumulation of data, had both lightened and increased its task. If the way was open to the solution of older problems, it was also beset by new problems which belonged, on one side at least, to physiology and physics. How the methods and results of these sciences could be turned to profit, without any sacrifice of its own method or autonomy, was, for psychology, not easy to determine. Fortunately, with some friendly discussion regarding metes and bounds, psychology has not only held its own, but has also rendered service to its neighbors.

It has not abandoned its traditional method. For the analysis of the various states, processes, tendencies and activities which appear in the individual consciousness, introspection cannot be dispensed with. If it is supplemented, as we nowadays say, by other methods, this implies not that self-observation of a keener sort is our prerogative, but rather that, with clearer knowledge of the conditions upon which our mental life depends, we are enabled to study each process both in itself and in its manifold relations. Comparison is thus a conspicuous and even an essential feature of modern psychological methods.

Psycho-physical research, as the name indicates, seeks to determine the relations between mental processes and physical processes. Whether this determination and its quantitative results should be called measurement, is still a subject for discussion. But there can no longer be any question as to the value for psychology of experimental methods. With the aid of these it is now possible to compare accurately changes in sensation and variations in the quality and intensity of external stimuli, to observe closely the organic modifications which accompany emotion, and to fix, within reasonable limits, the time-rate of the most complex processes. In a general way, of course, it has always been known that there was some sort of connection between the psychical and the physical; what modern psychology accomplishes is the more detailed and more exact investigation of that connection. Similarly with the phenomena of association, memory, attention, inhibition and fatigue; their importance has long been recognized, but their thorough analysis is the outcome of experimental work.

A complete solution of the problems that are offered in this portion of the field would leave on our hands the larger problem as to the development of consciousness. That mind is a growth, that its behavior in any given moment is affected by its behavior in all the past moments, all psychologists admit. But there is much to be learned regarding the successive phases of this growth. By what steps does the mind advance from the earliest impressions of childhood to the complex activities of adult life? What share in the process shall be assigned respectively to heredity, to the influence of environment, to the mind's own reaction by impulse, imitation and the growing consciousness of ends to be attained? The answer to such questions involves obviously a comparison between later forms of mental life and its simpler beginnings which may lead us far into the province of biology. Certainly no theory of evolution can afford to disregard the mental factors any more than psychology can overlook the results established by biological research.

This becomes more evident in view of the fact that both mental and bodily life may and too often does vary from the course of normal development. Those modifications which, either suddenly or gradually, reduce the mind to chaos, have in the past been studied chiefly on their practical side. They possess none the less an interest for psychology. By contrast at least they throw light on the normal activities of mind.

It should be noted, however, that in mental pathology as in psycho-physics and in the study of normal development, comparison is simply a means of getting new information concerning those processes which appear in the normal individual consciousness. To render this information available and to co-ordinate the multitude of facts which it contains or suggests, some sort of theory is necessary; and there is no lack of theorizing in modern psychology.

Owing, perhaps, to the predominance of comparative methods, the theory of psycho-physical parallelism is just now in vogue. It is agreed, in general, that mental processes and physical processes take place simultaneously, and to this extent the one series may be said to parallel the other. But beyond this, discussion is rife and the end is not yet. If, on the more orthodox view, it is claimed that the two series are merely parallel, i. e., without any causal nexus, it is urged on the other hand, especially in these latter times, that there must be interaction, mind producing effects in the organism and vice versa. While, again, it is maintained that the conscious processes have causal relations of their own—a specific psychical causality; it is also asserted that the causal relation exists for the physical processes only, and that mind gets its connectedness as an accompaniment of the bodily series.

The final adjustment of these claims may depend, in a measure, upon the eventual acceptance or rejection of the hypothesis, now favorably regarded, that every conscious state has for its organic basis the passage from centripetal effects in the brain to centrifugal effects, and consequently has its efferent or motor phase as well as its afferent or sensory phase. This hypothesis, however, leaves untouched the inquiry as to the precise way in which mind acts on body and body on mind. The latter problem, in fact, is essentially metaphysical. It points at once to the remoter region in which epistemology and criticism hold sway.

More than any other science, psychology finds itself obliged to canvass its results in the light of philosophy. Of late the statement has been made quite frankly that the way to psychology has its starting-point in philosophy. Be this as it may, psychology is, for the time being, at the stage of self-examination, taking an account of its titles to existence as a science. Not that it doubts of its proper object; the whole range of experience and of scientific thought is before it. But the question is: How can this object be laid hold of? The spontaneous, unreflecting attitude of mind is confessedly beyond the reach of investigation. And if by reflection we endeavor to describe and to explain the mental life, do we not construct for our own purposes an object which is more or less artificial?

This criticism implies no skeptical tendency. It surely will not deter psychologists from their work of investigating the more subtle elementary processes of mind, its unfolding in the individual and its relations to the complex activities of its environment.

* Popular Science Monthly.

THE REVOLUTIONARY INVENTOR.*

THERE is nothing constant but change, and pestilent inventors are now busy with their brains in the work of destroying the present Baldwin Locomotive Works, and will soon put all these railway magnates to their trumps in their effort to adjust their present cumbrous and costly methods of operating their roads to the more effective and less costly ones that will presently be presented to them. I have no doubt that many of the destructive inventors can hardly get their daily bread, but they cannot help inventing, whether they will or no. The Baldwin Locomotive Works have been in existence for two generations. Is there any building upon the ground which was there in the beginning? Is there any machine or tool in the works which was there even one generation ago? I guess not. Now, the profit of each generation has been in saving what the last wasted. The profit of each future decade will be only what was wasted in the preceding decade. Therefore our hosts must be prepared to reconstruct their whole works, to throw all their present tools and machines into the pile of scrap, and to follow the lead of these hungry inventors to see if they can keep up with the progress of science. Let me ask them at the risk of lack of courtesy if there is anywhere in existence a more wasteful machine than that locomotive No. 20,000? Can it convert into work more than 5 or 6 per cent of potential of the coal with which it is fed? Does it not waste ever 90 per cent of the energy of the fuel? The doom of the stationary steam engine is written upon the walls of the great works in which gas engines are now being made. I doubt if the locomotive can ever carry a gas-producing plant on its tender, else the doom of the steam locomotive would also be written. Now, let me ask the railway magnates how much energy they are wasting. Even if we do run only four wheels where our kin beyond the sea are said to run sixteen under their little freight cars, is there not still a lot of waste? Even if the old equation of one ton of merchandise to three tons of dead weight in the train has perhaps been trained to three tons of freight to one of dead weight, are you satisfied? How soon will you be forced to change again so as to carry five or six tons to one of dead weight? You are no more free from the nefarious work of the pestilent inventor than our hosts. In the end it all comes to one conclusion. The only accumulation that can be made in this world which possesses any duration or permanent value is mental energy. All that we can save is time, by making a reduction in the hours of labor and in the quantity of muscular effort now required by the work of getting a living. Whether you know it or not, the function of all you gentlemen who are in charge of the great works and great railways is to help on this progress in human welfare. You get your own board and clothing in compensation in common with all the workmen whom you capitalists serve as much as they serve you. In a material sense, our board and clothing is all that anyone of us can get in or out of life upon this planet. If all that the hand and brain of man has transformed of the crude products of nature into what we call capital; in other words, if all our great factories, warehouses, mills, railways, machine shops, goods and wares, could be converted back into food, clothing and shelter, and we then stopped work, we should consume it all and come to grief in less than three years. We cannot beat Old Time by more than two or three years; the sum of all our capital in material things does not exceed three years' annual product now, and probably never will. An old saying is: "Three generations from shirt sleeves to shirt sleeves." That is the common rule. Only those who can leave to their children the power of applying mental energy to the use of their material wealth will lengthen that term. That is the beneficent law of labor, whether the direction of the effort be manual, mechanical or mental. "In the sweat of his brow shall man always earn his bread."

* Edward Atkinson at the Commemoration Dinner of the Baldwin Locomotive Works.

WHAT DOES THE DESIGNATION C. P. MEAN AT PRESENT?

LYMAN F. KEBLER, discussing this question in a note presented at a meeting of the Franklin Institute, said: "C. P. in the chemical world undoubtedly meant, as it should to-day, a chemical of very high purity. But the expression as used at present by the chemist, the pharmacist, physician, the photographer, the broker, etc., may mean almost anything from a chemical substance of high purity to one of very secondary quality. For ample evidence of the latter it is only necessary to read over the advertising portions of some of the journals, where can be seen some of the absurdities of the designation c. p. For example, one manufacturer advertises chemically pure tar. That the designation c. p. may mean chemicals of ordinary purity can be seen by the following: An order was placed for c. p. zinc chloride and c. p. sodium bisulphite, two very difficult chemicals to make even of a fairly high degree of purity. What was wanted in this case were articles of good quality, 'commercially pure,' if you please. Nearly all manufacturers of glycerin mark their best quality c. p. and deliver it in iron drums, supposed to be galvanized inside. If such glycerin ever was c. p. it certainly cannot be expected in many cases to remain so very long under these conditions. Some c. p. drum glycerin contains iron to such an extent as to render it unfit for use in mixtures which contain carbolic acid or similar chemicals. As a matter of fact, very little available glycerin answers even the U. S. P. requirements, to say nothing of c. p. These glycerins almost all contain fatty acids and substances which reduce Fehling's solution." The author notes that certain prominent foreign manufacturers of chemicals have replaced the term c. p. with others, as "superior," "pure," etc.; while several houses in this country still use it freely. All chemists are aware, he remarks, that "it is practically impossible to make an absolute pure chemical in any quantity;" and he would like to see a set of standards or system of abbreviations established for chemicals and chemical compounds, so that upon proper designation the same quality would be furnished when and wherever called for.

THE KINETOSCOPE FOR SCIENTIFIC INVESTIGATION.

THE lecture rooms of the department of physics at the Massachusetts Institute of Technology, Boston, will be enlivened hereafter by the use of a kinetoscope. The machine is a first step toward equipping an instructor with apparatus that will enable him not only to illustrate his lectures with ordinary "motion pictures," but to transfer to the screen the continuous records of experiments in original research.

One of the many uses of the kinetoscope will be to illustrate the movement and character of air waves produced by the motion of any object, like the opening of the door, for example. The air is full of unnoticed sound waves, produced, not by sound, but by the various motions that make what we call sound. These waves travel at the rate of about 1,100 feet a second and yet it is asserted that they may be photographed under favorable conditions. The particular value of the kinetoscope for studying these waves lies in the fact that when the views are thrown on the screen in the lecture room the speed of the machine may be regulated to suit the observer and sound waves which actually travel at such extremely high speeds may be made to traverse the screen as slowly as desired.

Another use of the kinetoscope will be in showing the speed variation of a steam engine for the different positions of the stroke. The speed of an engine is kept constant within very minute limits by the inertia of the flywheel and where the flywheel is adapted to the conditions the variation can be detected only by the most sensitive apparatus. Alternating current generators, however, should have an absolutely constant motive power, and it is thought that the kinetoscope will afford an excellent means for studying the variation in speed of steam engines and may assist in formulating rules for proportioning the weight of flywheels or in adapting the mechanism of the engine to the requirements of the generator.

Very often greater speed instead of less speed is required in exhibiting a phenomenon on the screen of the kinetoscope. The Smithsonian Institution, in Washington, has recently afforded an excellent example of accelerated speed in its use of the kinetoscope in studying the growth of a plant. Kinetoscopic pictures were taken steadily and systematically as the plant grew; a delicate piece of work which required several months before the film was complete, and involved the use of an automatic flash light and other contrivances in order that the hourly growth of the plant could be observed from first to last. When the film was finished, however, it could be run through the kinetoscope as fast as the operator wished. As a result the plant could be seen, in the compass of a few minutes, actually growing from seed to maturity, each stage of growth being in the same proportion to all others as in the original development of the plant itself.—Machinery.

THE ISTLE FIBER OF MEXICO.

By CHARLES RICHARDS DODGE.

A FIBER ranking second in commercial importance among the fibers of Mexico—the henequen of Yucatan always standing first—is the "Istle," "Ixtle" or "Tampico" of commerce, which is produced in large quantities from uncultivated plants that cover vast areas in the eastern and northern portions of the country.

Its chief use in the United States is for the manufacture of brushes, being a substitute for animal bristles, though it admits of other uses. In Mexico it is used alone, or with other fibers, in the manufacture of bagging, pouches, to a limited extent for cordage, for girdles for pack animals and for other local uses. About 90 per cent of the Tampico fiber is derived from a species of the family *Amarylladaceæ*, known to botanists as *Agave heteracantha* (Fig. 1), a small aloe-leaved plant rarely attaining more than a height of two feet, though often growing larger

FIG. 1.—ISTLE PLANT.

in the mountains, and always smaller on the more arid levels.

The plants produce themselves by millions over the plains or plateaus, and up the mountain sides, of the States of San Luis Potosi, Tamaulipas, Nueva Leon, Chihuahua, Coahuila and to an extent in adjacent States, also reaching over the border into Texas. The chief centers of the industry are the towns of San Luis Potosi, Saltillo, Victoria, Jaumave, Tula, Monterey, Matamoras to an extent, and Tampico, the latter being the Gulf shipping port, from which the commercial name of the fiber is derived. At the present time the United States imports annually about 6,000 tons of the fiber at the value of $72 per ton, these figures representing only a portion of the fiber exported from Mexico, other countries taking a large supply, while the native demand is considerable. Undoubtedly the present demand in the United States would be largely increased, were the fiber experi-

FIG. 2.—NATIVE WITH BASKET OF CLEANED FIBER.

mented with for other uses than as brush material, and the demand could be readily met as the supply of raw material is almost limitless.

An interesting feature in relation to the production of this fiber is the fact that every pound of the commercial and local supply is extracted by native Indian hand labor, its production, in the aggregate, serving to maintain an army of these simple, hard-working people as well as their families. It may be stated that the average amount earned by a native for a day's labor is about 37 cents Mexican silver, or about 16 cents reduced to gold value.

My principal investigations relating to this industry were made near one of its chief centers, Jaumave, at the hacienda Las Pilas, owned by the brothers Zorilla, the farm covering about ten miles square in territory, although I traveled through a considerable portion of the entire Istle region. A study of the social economy of many of these Mexican haciendas reminds one of the old feudal system of Europe, where the castles of

FIG. 3.—ISTLE KNIFE.

the barons were surrounded by the rude homes of the vassals, who contributed their brawn in toil, or their zeal in arms to the feudal lords of creation who ruled the land.

Around the hacienda buildings proper, which are often inclosed by high walls, are clustered the palm-thatched huts of the natives, dotting the hills and levels in every direction. In the main building, usually a low adobe structure, wall high, is the office of the farm where is prominently seen the rude desk, and the scales for weighing, as well as an array of arms, saddles and trappings on pegs in the wall, and other objects of like utility. In the next room is the store where the peon, after being credited in the office with the value of the product of his toil, goes to purchase supplies of corn, beans, sugar, coffee, meat, fabrics for his rough clothing, zarapes, sombreros and other necessities of life, these things being charged against his account—all working for and dependent upon the wealthy owners.

Fig. 2 shows a native returning toward evening with the result of his day's labor carried in one of the curiously wrought basket-like receptacles with which all are provided. Starting away from his hut in the morning, after a breakfast of tortillas, frijoles and black, muddy coffee, or sometimes without the coffee, he wanders away into the brush, often going several miles to find a locality where the "*lechuguilla*" plants

FIG. 4.—CLEANING ISTLE FIBER.

are found most thickly. His first work is to gather the material from which the fiber is to be extracted. Past writers have said that this material was derived from the "leaves" (presumably the free or opened leaves) of the plant, but such is not the case, as only the *cogolla*, or central spike of unopened leaves, is taken. This part of the plant gives a fiber of superb color, with other good qualities, and is readily extracted, while the old, or side leaves, give a harsher, dirtier looking fiber, and are much more difficult to clean.

Armed with a slender rod, about the length of a broom handle, terminating at the lower end in a steel ring about an inch and a half in diameter, the native selects a plant, drops the ring over the *cogolla*, or central leaf spike, settles it well down into the cluster of opened leaves, and with a dextrous jerk breaks off the *cogolla* at the point of intersection with the plant. In half an hour or more his basket is filled with these *cogollas* and he retires to the shade of a bush, where the real work of the day commences. First, he produces a narrow, knife-like instrument of iron, quite thick but with a smooth, blunt edge; it is about a foot

FIG. 5.—STOREROOM IN HACIENDA.

in length, the point being turned up and rather sharp (Fig. 3). Leveling off a spot of ground, always at the base of some woody growth, he inserts the point end of the knife into a hole worked in the bark, sometimes of the very bush which shelters him, but always near the root. The insertion of the knife point gives him leverage for its subsequent manipulation in the operation of scraping the leaf to clean the fiber. Upon the ground, under the knife, and placed transversely to it, is placed a billet of wood a foot or fifteen inches long, and three or four wide, with a smooth face, which serves as a kind of "bed plate," or resistant surface, upon which the leaf can be manipulated in the operation of scraping. Selecting a *cogolla*, he rapidly separates the unopened leaves of which it is made up, throwing away the shorter or embryo leaves found in its center. Grasping one of these detached leaves in the left hand and the knife handle in the right, the leaf is held flat upon the block of wood, while, with the pointed end of the knife firmly fixed into the trunk of the bush—to enable him to gain a purchase for leverage—he draws or jerks the leaf toward him, at the same time throwing his weight down upon the knife, which, swinging around on its point, is moved away from him. Two or three repetitions of this movement, on either side of the leaf, scrapes away all of the epidermis and pulp, leaving the glistening yellowish fiber. The leaf is then dextrously reversed, the clean fiber being wrapped around a bit of wood or a piece of corn cob (to enable him to hold it), and again grasping firmly in the left hand, the uncleaned end goes through the operation previously described, and the wisp of fiber is laid on the pile (Fig. 4). So the monotonous work goes on through the long day until the requisite quantity for a proper day's work

FIG. 6.—FIBER-LADEN BURROS.

has been produced. The fiber is taken to his hut and spread out in the sun to dry, after which it is bound in bundles, five inches or less in diameter at the butt, when it is ready to turn in at the hacienda for weighing and credit.

Nothing further is done to the fiber, save to store it in a special room (Fig. 5), no attempt being made even at sorting. When a sufficient supply has accumulated for transportation, the small bundles are made up into larger bundles, weighing 75 pounds, bound with stout ropes, and on a given day a pack

train of burros is started on the fifty-mile journey over the mountains to Victoria, each little animal carrying two or more bundles (Fig. 6). The account of this journey over the mountains would make an interesting chapter, but it is not essential to the present story.

Arriving at Victoria, the fiber goes to the warehouses, where there is some attempt at grading as to quality, but rarely ever as to length, packed in bales of 240 pounds, wrapped with bagging made from the same fiber, and stenciled for shipment. The bales are then sent to Tampico by rail and are subsequently shipped by water to the markets of the world.

Tampico fiber is harsh, stiff and very resistant, but pliable, of a whitish yellow tint, and of various lengths from one to two feet, fifteen to eighteen inches being the average. I have seen superb samples from the mountains back of Jaumave that would measure thirty inches, and if a sufficient supply could be secured to warrant the hacienda owners in sorting the fiber as to length, it would find a ready market for cordage purposes to be used with other fibers, its pliancy and resistance being marked qualities. The native name "*lechuguilla*," is universally employed in Mexico, applying to both plant and fiber, though this name, and "Istle" as well, is given to other plants of this family found in other portions of Mexico, usually with a qualifying adjective. An allied form is the *lechuguilla maguay* of Southern California, which yields even a coarser fiber. It was machine-extracted by me, experimentally, some years ago, but the fiber did not find favor in the eastern market.

At San Luis Potosi, in the works of a leading company, I saw the operation of weaving the Istle fiber into bagging, the rude loom and the operator being shown in the accompanying picture (Fig. 7). At the same place I also witnessed the spinning of the small cordage, or yarn, by hand, our illustration (Fig. 8) showing the spinners, who walk backward across the long court while the yarn is being spun.

A machine has recently been invented to clean the *cogolla* of the true *lechuguilla*, or Istle, but it is still under experiment. The use of machinery would revolutionize the business, but it would be a sad day for the peons of eastern Mexico when they become extensively used. While this is one of the most interesting fiber plants of Mexico, they are all interesting, and their numbers are legion.

FIG. 7.—WEAVING ISTLE BAGGING BY HAND.

FIG. 8.—SPINNING ISTLE YARN BY HAND.

VITALITY OF DISEASE GERMS.

GAFFKY (Zeit. f. Hyg. u. Infect.) finds that microbes retain their vitality much longer in dimly lighted than in sunny rooms. This may be one reason why disease germs flourish better in winter than in summer, owing to the lesser hours of sunlight. He points out that influenza epidemics have never occurred in Germany except when the weather has been long cloudy. The vitality is also directly proportional to the size of the particle of dust or moisture. The germ dies more rapidly the finer the particles. In his tests with droplets such as are expelled in speaking, sneezing or coughing, he found that the bacillus prodigiosus and the typhoid bacillus retained their vitality 24 hours in daylight; the diphtheria bacillus 24 to 48 hours in daylight and 5 days in a cellar; the tubercle bacillus 5 days in daylight and 22 days in a cellar; the fowl cholera bacillus 10 hours in daylight and 24 hours in the cellar; the staphylococcus pyogenes aureus 8 to 10 days in daylight and 35 days in the cellar; the streptococcus longus 10 days in daylight and 38 days in the cellar, and anthrax spores 10 weeks in daylight, and at least 3 months in the cellar.

TO PRESERVE CUT FLOWERS.

ACCORDING to Health, cut flowers may be kept fresh for weeks by the following method: "A vessel of water is required large enough to allow the submersion in it of a plate or dish holding the bouquet to be preserved, and a bell glass to cover the flowers. The dish or plate should contain no moss or other material; the water should be limpid and quite pure. Place the plate at the bottom of the water, and on the plate, submerging it, put the bouquet, which is maintained in an upright position by a weighted base previously attached to it. This being done, the flowers are covered with a bell glass, the rim of which ought to fit exactly to the flat part of the plate; the bell glass should be entirely filled with water, and without the least air bubble. Then all are raised together, plate, bouquet, and bell glass filled with water, and placed on a table, carefully wiping the exterior, but leaving on the plate, around the base of the bell glass, a little provision of water, which prevents the entrance of air. The flowers in this condition will be preserved in all their freshness for several weeks, and their beauty is increased by a great number of bubbles of gas produced by the respiration of the leaves, and which attach themselves to the petals, appearing like pearls." Of course this prevents the odor of the flowers being perceived; but invalids or others who cannot have them frequently renewed may prefer long continuance of sight at the sacrifice of fragrance.

A MODERN TOUCHSTONE.

EVER since the immortal Touchstone classified for the benefit of posterity, the degrees of mendacious and impudent repartee, we have been familiar with the "retort courteous." To the everlasting joy of Billingsgate, an industrious German philologist, Herr Schuch, has mapped out for its benefit the extensive ramifications of the retort courteous. In other words, Herr Schuch has compiled a list of 2,500 insulting expressions, which if not always courteous, are at least appropriate. With true Teutonic patience and scientific care, Herr Schuch first of all divides his retorts into five fundamental classes, corresponding to the different kinds of persons who are to be insulted. Thus we have insults for men, insults for women, insults applicable to either sex, insults for children and collective insults for syndicates, groups and corporations. Once upon a time it was said that corporations being but artificial persons had neither bodies to be kicked nor souls to be damned. But if Herr Schuch is to be relied upon they may at least be bombarded with scathing insults. The immense possibilities of the "Schimpfwoerter Lexicon," which is the title in which Herr Schuch's book rejoices, are obvious. If a man should be insulted at any time, he has but to pull the lexicon out of his pocket, turn to the particular heading under which persons of his opponent's stamp are catalogued, select the appropriate word and probably outdo his reviler. From the legal standpoint, the lexicon certainly must commend itself to everyone who wishes to insult without incurring an action for slander. It would be perfectly safe and effective to turn to the lexicon, pick out some particularly choice insult, and refer one's enemy to the particular page and line on which it may be found.

FIG. 9.—NATIVE INDIAN HUTS IN ISTLE REGION OF MEXICO.

THE PRACTICABILITY OF WIRELESS TELEGRAPHY.

By G. MARCONI.

THE first paid message by etheric wave telegraphy was sent by Lord Kelvin on June 3, 1898. The circumstances were these: Lord and Lady Kelvin and Lord Tennyson visited my Alum Bay station in the Isle of Wight. I explained the working of the apparatus and showed how messages were sent and received. Lord Kelvin was so much pleased with what he saw that he desired to send telegrams to various friends on the mainland of England, insisting first that he be permitted to pay for their transmission to Bournemouth at the rate of a shilling royalty per message in order to show his appreciation of the system and to illustrate its immediate availability for commercial use. Messages were sent by Lord Kelvin to Dr. MacLean, his chief assistant in the physical laboratory of the University of Glasgow, to Sir George Stokes, at Cambridge, and to Lord Rayleigh and Sir William Preece in London.

He has given his permission to reprint one of the messages—that to Sir George Stokes:

"Stokes, Lensfield Cottage, Cambridge. This is sent commercially paid at Alum Bay for transmission through ether, 1s. to Bournemouth, and thence by postal telegraph, 15d. to Cambridge.—Kelvin."

Lord Tennyson's message was to his nephew at Eton, and was as follows:

"Sending you message by Marconi's ether telegraph, Alum Bay to Bournemouth, paid commercially, thence by wire; very sorry not to hear you speak your Thackeray to-morrow.—Tennyson."

Commenting on these messages, the Electrical Review of June 17, 1898, says:

"With the achievement of these striking results, one ought not to wait long before a practical application is made of the wireless telegraph."

The success of my various trials led me to desire some opportunity of testing the practical application of my system on a more extended scale. It is difficult with a new invention such as mine to convince the public, even after the most successful trials, that here is something that should and must be adopted. In a sense it must create a new field for itself, as well as threaten established rivals in old fields. Not only was I compelled to construct a satisfactory apparatus for telegraphing wirelessly, but I had to show by actual tests some of the ways in which it could be utilized—all of which required much time and money.

I welcomed, therefore, the opportunity presented to me in July, 1898, of showing the practical serviceability of my new system in reporting the races of the Kingstown Regatta for the Dublin Express. One of my assistants fitted up a land station at Kingstown and another set up instruments on board the steamer "Flying Huntress." During the progress of the race the "Flying Huntress" followed the course of the yachts, and wireless messages were sent shoreward every ten or fifteen minutes. Several hundred bulletins were dispatched and not a single message had to be repeated.

The land station was in a room at the rear of the residence of the harbor-master. A wire from the instruments was carried to the top of a mast forty feet in height, on which was suspended a wire netting arrangement corresponding to that attached to the mast of the steamer. While the tug was running down to the Kish lightship the final preparations were made for receiving and transmitting messages. The test for finding whether the instruments were sensitive enough is a very simple one. The operator takes an ordinary electric bell, which he holds at some distance from the Morse indicator. He sends out from the battery of the bell a very tiny current, which is instantly responded to by a click, or by the sound of the bell on the indicator. This is of itself a very simple exhibition of wireless telegraphy.

At length all was in readiness, and the first message was received from the tug. The tape emerged with the familiar dots and dashes beautifully printed, ready to be translated for the reporter. As fast as the messages arrived they were telephoned to the office of the newspaper in Cork Hill. The operations were carried out with precision, and in a perfectly matter-of-fact manner.

"Is it an Irish characteristic," said a writer of the Express, who was a partner of the experiments, "or is it the common impulse of human nature, that when we find ourselves in command of a great force, by means of which stupendous results can be produced for the benefit of mankind, our first desire is to play tricks with it. No sooner were we alive to the extraordinary fact that it was possible, without connecting wires, to communicate with a station which was miles away and quite invisible to us, than we began to send silly messages, such as to request the man in charge of the Kingstown station to be sure to keep sober, and not to take too many 'whisky-and-sodas.' Playing in this way with the great invention probably enabled us to realize better the means at our command than we should have done if the mail boat, which passed us during the afternoon, had gone aground on the Kish Bank, and we had been able to avert a catastrophe by sending the news to shore. What really impressed us most of all was the fact that by depressing a key at Kingstown it was possible to ring a bell on the 'Flying Huntress' lying out in the neighborhood of the Kish light. It is on the same principle that one is more impressed by seeing a steam-hammer crack a nut than by seeing it crush a ponderous mass of ore."

The following portion of the description of one of the races sent by wireless telegraphy, and published in the Evening Mail and Daily Express, may be of interest:

"10:55. The 'Rainbow' having crossed the line before the gun was fired, was recalled, thereby losing 3¼ minutes.

"11:25. Time round Rosbeg buoy:

	H.	M.	S.
"Ailsa"	10	54	0
"Bona"	10	54	30
"Isolde"	10	58	0
"Rainbow"	10	59	0
"Astrild"	10	59	45

"The 'Ailsa' stayed, and went away on the port tack, as did also the 'Astrild.' After going a short distance, the 'Bona' also stayed, following the example of the other two, the 'Rainbow' and the 'Isolde' standing in under Howth.

"11:17. The 'Rainbow' and the 'Isolde' are still standing on the port tack, getting a nice breeze, the 'Isolde' being well to weather, the 'Ailsa' and 'Bona' having gone about on the same tack. 'Astrild' stood to southward to get the first of the ebb tide, and is now heading for the ship."

The race reports were entirely satisfactory in every respect, a large number of bulletins being sent, so that the race news was issued by the Express much earlier than it could have been in any other way. The "Flying Huntress" was constantly in motion, of course, but this made no difference in the legibility of messages. The distances crossed were small, from five to ten miles.

ON THE ROYAL YACHT.

About this time the Prince of Wales, then stopping with Lord Rothschild, had the misfortune to injure his knee most severely, so that he was confined to the royal yacht "Osborne" in Cowes Bay. The Prince had already expressed his interest in wireless telegraphy, and when the Lord Lieutenant of Ireland asked if communication between the royal yacht and Osborne House, Isle of Wight, could be established, I told him I would be delighted to make the necessary installations. We were not long in putting up our stations, and once up there was no hitch in the working either way.

The first telegram sent was:

"The Prince of Wales sends his love to the Queen, and hopes she is none the worse for being on board yesterday."

More than 150 messages were sent in the sixteen days I was on the royal yacht, many of great length. Every morning a bulletin was sent to the Queen, of which the following is a sample:

"August 4th.

"From Dr. Fripp to Sir James Reid.

"H. R. H. the Prince of Wales has passed another excellent night and is in very good spirits and health. The knee is most satisfactory."

"August 5th.

"From Dr. Fripp to Sir James Reid.

"H. R. H. the Prince of Wales has passed another excellent night, and the knee is in good condition."

The instruments on the yacht were operated and observed with great interest by the various distinguished persons aboard, notably the Duke of York, the Princess Louise, and the Prince of Wales himself. What seemed to amaze them above all was that the sending could go on just the same while the yacht was in rapid motion. The following message was sent on August 12 by the Prince of Wales while the yacht was steaming at a good rate off Bembridge, seven or eight miles from Osborne:

"To the Duke of Connaught.

"Will be pleased to see you on board this afternoon when the 'Osborne' returns."

The Electrical Review, August 19, 1898, gives some particulars as to the methods employed:

"The height of the mast on shore was 105 feet, and that of the top of the wire from the deck of the 'Osborne' was 83 feet. The yacht was moored in Cowes Bay, at a distance of nearly two miles from Osborne House, the two positions not being in sight of one another, as they were intercepted by a hill to the rear of East Cowes, which would have rendered signaling impossible between these two stations by means of any optical system. The messages varied in length, some having as many as 100 to 150 words, which is tantamount to a decent letter. Mr. Marconi's assistants were on duty from 9 A. M. until 7:30 P. M. without intermission during the whole period. Toward the end of the time, on the 10th instant, the yacht went on a cruise toward Sandown, and the messages were received correctly close off the 'Nab' lightship, which is moored off Bembridge. On the way there, when under steam, a lengthy message was received by the Prince from the Duke of Connaught, and the reply was successfully dispatched, though well out of sight of Cowes and Osborne. On the 12th instant the yacht cruised as far as the Needles, or rather outside, and went on until the instruments picked up Alum Bay station—the Needles Hotel—continuing in communication with them all the way, perfect messages being passed to and from. Communications were kept up throughout the cruise with either the Osborne station or the Wireless Telegraph Company's station at Alum Bay. During the whole of the cruise the 'Osborne' pole was obscured, and all the messages had to pass over land, and the Alum Bay pole was also obscured until coming right into the bay, on account of the station being situated very much below Heatherwood. The messages were sent to Alum Bay from a distance of nearly seven and a half miles, although the ground lying between was exceedingly high; in fact, it was about the highest land met with during the time. It was so high that the poles were screened by hundreds of feet.

"The Prince of Wales and other royalties gave expression to Mr. Marconi of their high appreciation of his system, and their astonishment at the perfection to which it had been brought. The Prince presented Mr. Marconi with a souvenir in the shape of a very handsome scarfpin, and wished him every success with his interesting invention."

One of the first and most commonly suggested uses for wireless telegraphy was for connecting lightships and lighthouses lying off shores on dangerous rocks or shoals with land stations. The year 1898 was to see the first installation of this nature, between the East Goodwin lightship, located over one of the most dangerous shoals on the British coast, and the South Foreland lighthouse, twelve miles distant. Communication was first established on Christmas eve, 1898, just about four years after my first experiments in wireless telegraphy were made in Italy, and the apparatus had remained in active and successful operation for nearly two years.

The Deputy Master of Trinity House has publicly stated that there was never a hitch from the start, and that he could indorse every word I said in my lecture before the Institute of Electrical Engineers (March, 1899) regarding the practicability of the apparatus.

The Prince of Wales, as president of the Royal National Lifeboat Institution of Great Britain, expressed himself to the same effect, and said that at last a system had been found which would make navigation much safer and diminish the perils at sea.

Indeed, the apparatus had not long been installed before its value was shown most conclusively by the saving of the lightship herself. She was run down at 4 o'clock on the morning of March 3, 1899, by the steamer "R. F. Matthews," outward bound from London. The wireless telegraphy operator hurriedly called up South Foreland lighthouse, said that the lightship had been run into and was leaking. Lifeboats were sent out at once and the lightship was saved. Since then several other ships have gone upon the sands and assistance has been obtained by means of wireless telegraphy, the operators telegraphing ashore in each case.

The success of the installation between the East Goodwin lightship, and the South Foreland lighthouse awakened great interest, and the public began to see the practical uses to which the system might be put.

THE INTERNATIONAL YACHT RACE.

My first American tests were made during the International Yacht Races in 1899. Shortly after the Kingstown Regatta, the New York Herald arranged with me to report by wireless telegraphy the yacht races between the "Shamrock" and the "Columbia," which took place in New York Bay in October, 1899. There was nothing different, so far as my methods were concerned, in this work, from what had been accomplished long before, but the subject is worthy of mention in a chronology of the system because of the interest manifested in the trials by the American people. With three assistants, Mr. Bradfield, Mr. Densham and Mr. Richard, I arrived in New York on September 29, and on the following day was joined by another assistant, Mr. W. Bowden, who had been conducting experiments in Newfoundland, and had given demonstrations before the Houses of Parliament there. In a few days we had fitted up a land station at Navesink, near Atlantic Highlands, in New Jersey, and ship stations on the cable ship "Mackay Bennett," and on the steamer "Ponce." The "Ponce" followed the course of the racing yachts and sent frequent bulletins to the shore station whence they were cabled to all the principal cities of the United States, and to the cable ship, whence they were cabled to London, Paris and other points in the East.

The suspended wires were about 150 feet high in all cases and the distances through which the messages were sent varied from five to twenty miles. The instruments were located in the chart rooms of the ships, and messages were sent at intervals of not more than fifteen minutes. Naturally the many failures of the yachts to reach decisive results were disappointing, but in every case, in spite of storm or fog, the messages I sent were accurate and much in advance of all other means of transmitting the news.

One of the interesting, perhaps amusing, facts connected with my work in America was the diversion caused by rival claimants for wireless telegraphy honors. They believed, and wanted others to believe, that I was receiving credit that belonged to them, which is a not unusual claim in connection with any successful invention.

I am grateful to the SCIENTIFIC AMERICAN for this expression regarding my work:

"Whatever may be the merits of this controversy, we are satisfied that it would be as easy to sweep back the tide with a broom as to prevent the system of telegraphy which has just done such good work off New York Harbor and with the English Fleet from becoming for ever identified with the name of the man who first brought wireless telegraphy to a practical and useful consummation."

Before the races began we went over the course carefully, and the first day's trial showed me that nothing could prevent the correct working of the apparatus. From the start down the Bay messages were flashed back and forth with unvarying accuracy, in spite of intervening objects. Many private messages were sent to be forwarded to Washington, or to be cabled to Europe; engagements were made for dinners in New York that evening, and so on.

At the close of the trial cruise, which reached an extreme distance of twenty-two miles, my assistant, Mr. Bradfield, telegraphed:

"Everything has gone off first rate all day. Signals could not have been better if we had been connected with you by wire."

The work of reporting went on regularly during the races, over 1,000 words being transmitted daily. It acquainted the American people with my purpose, and the possibilities of my invention. I was much gratified at the generous treatment accorded me by the American people.

UNITED STATES NAVY TRIALS.

Immediately following the yacht races I was requested to make some experiments for the United States navy. The cruiser "New York," and the battleship "Massachusetts," were arranged for the demonstrations. The commission in charge of the test consisted of Lieut.-Commander J. T. Newton, Lieut. John B. Blish, and Lieut. F. G. Hill. Lieut.-Commander Newton was with me on board the "New York," and directed the experiments required by the Navy Department. Lieut. Hill was on the "Massachusetts," and Lieut. Blish was at the Highlands of Navesink, where a wireless telegraphy apparatus was rigged for the purpose of interrupting the messages.

Curiously enough, one of the first requests of the officers was for official proof that the system could be operated for short distances, and two or three days were spent in the East River signaling a few hundred feet. In view of the fact that three navies of Europe had used the systems at distances varying from twelve to eighty miles, the following comment from the New York Times is not without point:

" . . . Is there not something a little provocative of smiles in the 'tests' of wireless telegraphy now making by the Navy Department? It was so very well

known to all who have paid the slightest attention to the operation of Signor Marconi that much more can be accomplished by the aid of his device than was attempted in Thursday's experiments! To send signals and messages between warships anchored a few hundred feet apart is a task vastly easier than others which he performed with complete success months and months ago, and surely our naval officials should not need to enter the primer class in this method of communication. There was a trace of deserved sarcasm in the inventor's tone when he said that the telegraphing done on this occasion was a trial of the operators' skill, not of the system. The curious slowness of the government in taking up new ideas and new implements has often had expensive consequences, and more than once it has had tragical ones, as in the case of smokeless powder and high-power rifles. At present, apparently, they are tempting the laughter of foreigners by treating as novel things that have long been matters of common talk among amateur and professional scientists alike."

However, under direction of Rear-Admiral Farquhar, the ships proceeded out to sea a few days later, and very satisfactory results were attained up to thirty-six miles, the longest distance attempted.

The apparatus on the "New York" consisted of a vertical wire attached to a wooden mast and sprit fastened to the mainmast of the cruiser. The wire, at an acute angle with the mast, extended from the top of the sprit to the after gunroom of the warship, just over the propeller on the gun deck, where it was attached to the telegraphing apparatus. The "Massachusetts" was fitted with a similar contrivance. At the Highlands of Navesink a 150-foot mast was erected, and a vertical wire and electrical attachment of the same kind used by the warships was set up. The electricity used for sending the wireless telegraph messages was furnished by a relay of dry-cell batteries specially prepared for the purpose. Each one of the telegraph instruments was equipped with a Morse inkwriter, so that the messages received were recorded on ordinary tape in the Morse code. At a point about five miles off the Highlands of Navesink, the "New York" anchored, while the "Massachusetts" maneuvered about the flagship.

The first few messages sent back and forth between the two warships consisted of orders to the "Massachusetts" as to the rate at which she was to keep under way, and questions as to the distance she had covered. Then a long dispatch was sent from the "New York" to the "Massachusetts," with the instruction that it be repeated to the sender word for word. This message was sent and repeated without an error. Then messages were sent to the "Massachusetts" and to Navesink ordering the operators there to send messages simultaneously to the "New York."

The purpose of this order was to have Navesink interrupt the message from the "Massachusetts" to the "New York." This interference test was in every way successful, with the result that the two messages sent at the same time were jumbled into utter confusion. The dots recorded on the tape of the inkwriter were indiscriminately ticked off and absolutely unintelligible.

The messages between the two warships at intervals of ten minutes, with interruptions from Navesink at longer intervals, were kept up until the "Massachusetts" was thirty-six miles from the "New York," and then the battleship put about and came back.

Two days later further tests were made. Among the messages received by the "New York" there came suddenly a dispatch from the "Massachusetts" reading: "Man overboard." The message was given to Capt. Chadwick, and a cutter was lowered from the "New York." Ten minutes had elapsed from the time the wireless message was received before the same news was conveyed to the flagship by the wigwag man on the bridge of the "Massachusetts." Before the cutter had even been lowered from the "New York" to put out for the man who had fallen overboard from the "Massachusetts," another wireless message was received saying that the man had a buoy and was safe. Before beginning the test for the United States Navy Department, I sent the following letter to the Commission appointed to make the tests:

"To the Board appointed by the United States Navy Department to report on the trials of Marconi's system of wireless telegraphy:

"Gentlemen: With reference to the tests of my system which are now being carried out under your supervision, I wish to state:

"First—That the installation fitted up at the Navesink Highlands lighthouse has been installed to meet the wish expressed by various members of your Board in order to facilitate their investigations, but I want it to be understood that the instruments now at the station are not as efficient (being of an earlier type and intended for short-distance demonstrations) as those installed on the "New York" and "Massachusetts," and results obtained at that station cannot be taken as a test of the system in its present state.

"Second—Having consulted with my partners, I regret to be unable to give a demonstration of the devices I use for preventing interference, and of the system employed for tuning syntonizing instruments. The reasons why I cannot give such demonstrations are:

"(*a*) The means employed are not yet completely patented and protected.

"(*b*) Insufficient material and instruments here with me to give full demonstration.

"(*c*) No detailed information from the United States Navy Department was received by my company prior to my departure from England as to the extent of the demonstrations required.

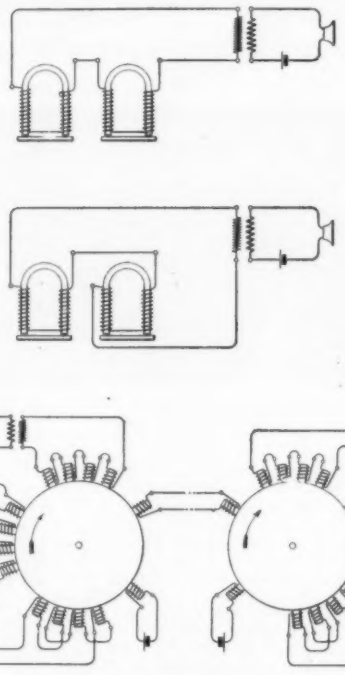
"Since I last had the pleasure of meeting you, I have received advices from England to the effect that the British government has decided to make use of my system in the present South African war and also on the fleet. This necessitates my company supplying to the British government a large number of instruments and expert assistants, and also further necessitates my early return to Europe. I shall, therefore, be unable to continue the tests for the United States Navy Department after Wednesday.

"I am, gentlemen, your obedient servant,

"G. MARCONI."

The report of the United States Navy Commission concerning wireless telegraphy trials is here given:

"We respectfully submit the following findings as the result of our investigation of the Marconi system of wireless telegraphy: It is well adapted for use in squadron signaling under conditions of rain, fog, darkness and motion of speed. Wind, rain, fog and other conditions of weather do not affect the transmission through space, but dampness may reduce the range, rapidity and accuracy by impairing the insulation of the aerial wire and the instruments. Darkness has no effect. We have no data as to the effects of rolling and pitching, but excessive vibration at high speed apparently produced no bad effect on the instruments, and we believe the working of the system would be very little affected by the motion of the ship. The accuracy is good within the working ranges. Cipher and important signals may be repeated back to the sending station, if necessary, to insure absolute accuracy. When ships are close together (less than 400 yards) adjustments, easily made, of the instruments are necessary. The greatest distance that messages were exchanged with the station at Navesink was 16.5 miles. This distance was exceeded considerably during the yacht races, when a more efficient set of instruments was installed there. The best location of instruments would be below, well protected, in easy communication with the commanding officer. The spark of the sending coil or of a considerable leak, due to faulty incitation of the sending wire, would be sufficient to ignite an inflammable mixture of gas or other easily-lighted matter, but with direct lead (through air space, if possible) and the high insulation necessary for good work, no danger of fire need be apprehended. When two transmitters are sending at the same time, all the receiving wire within range receives the impulses from the transmitters, and the tapes, although unreadable, show unmistakably that such double sending is taking place. In every case, under a great number of varied conditions, the attempted interference was complete. Mr. Marconi, although he stated to the Board before these attempts



MULTIPLEX TELEGRAPHONE.

were made that he could prevent interference, never explained how or made any attempt to demonstrate that it could be done. Between large ships (height of masts 130 feet and 140 feet) and a torpedo boat (height of mast 45 feet), across open water, signals can be read up to seven miles on the torpedo boat and eighty-five miles on the ship.

"Communication might be interrupted altogether when tall buildings of iron framing intervene. The rapidity is not greater than twelve words per minute for skilled operators. The shock from the sending coil of wire may be quite severe and even dangerous to a person with a weak heart. No fatal accidents have been recorded. The liability to accident from lightning has not been ascertained. The sending apparatus and wire would injuriously affect the compass if placed near it. The exact distance is not known, and should be determined by experiment. The system is adapted for use on all vessels of the navy, including torpedo boats and small vessels, as patrols, scouts and dispatch boats, but it is impracticable in a small boat. For landing parties the only feasible method of use would be to erect a pole on shore and then communicate with the ship. The system could be adapted to the telegraphic determination of differences of longitude in surveying. The Board respectfully recommends that the system be given a trial in the navy."

The call from England was now imperative. Already six of my assistants with full equipment of instruments had started for the Transvaal, and there seemed a probability that more would be called upon. I was, therefore, obliged to stop the work for the United States navy and also the negotiations with the Signal Service Corps under General Greely. On the eve of my departure the Navy Commission expressed great satisfaction over the results.

FURTHER PROOFS OF PRACTICABILITY.

While I was in New York, the British Association for the Advancement of Science met at Dover, the French at Boulogne and the Italian at Como. Under the direction of my good friend and adviser, Prof. Fleming, of University College, London, my system was used in a demonstration before the English and French bodies, and frequent messages were sent across the Channel from one to the other. On the centenary of the day when Volta's great discovery of the electric current became known to the world, messages of congratulation were sent by the English Association through the ether to the French scientists, thence on to the Italian body by land wires.

Again, a most convincing proof of practicability was given on the afternoon of November 15, 1899, on board the "St. Paul," in which I was returning to England. I had notified my company in London that I would communicate with our stations at Alum Bay and The Haven from the incoming steamer. Because of the hurried orders to South Africa, these two land stations had been dismantled and the instruments taken to London, but the day before my arrival Major Flood-Page and Mr. H. Jameson Davis, with assistants, rigged up the stations and awaited signals from me. On the ship we waited until the morning of the 15th, and then secured our vertical wire to a sprit fastened to the mainmast and set up our instruments in the smoking room. It was while we were still sixty miles from Southampton that we received the signals. Within another hour, still over forty miles away, we had received their "Is that you, 'St. Paul'?" and then "Hurrah, welcome home, where are you?" Then came war news, four hours before we landed, and we sent telegrams ashore for officers and passengers of the ship. The enthusiasm of all those aboard led to the publication of a paper, which was sold for a dollar a copy for the benefit of the Seamen's Fund, for which $150 were raised.—From Fortnightly Review. Leonard Scott Publishing Company, New York.

THE MULTIPLEX TELEGRAPHONE.

POULSEN'S assistant, Peder Oluf Pedersen, has received United States patents for a method of using the Poulsen telegraphone so as to record a number of messages on a single steel strip and to reproduce them without confusion. As a result of his improvement, it follows that the size of the drum, or the length of the wire used is reduced, so that a long speech can be recorded upon a very short magnetic body.

The gist of the invention is to be found in the use of two or more recording magnets, the connections of which are varied with each message with a corresponding variation in the combined action of the magnets on the recording strip. To reproduce this message, the connections of the magnets must be adjusted to the same combination used in impressing it. The first two of our engravings show that two messages can be recorded on and reproduced from the same portions of two adjacent steel strips. The third figure shows how several messages can be simultaneously transmitted over a single line by means of the telegraphone. In Figs. 1 and 2, two separate steel ribbons are drawn past the poles of two horseshoe magnets, connected in series with the secondary of the telephone circuit. By means of plugs, the connections of the magnets in the circuit can be varied. A message spoken into the transmitter will be recorded magnetically on the strips and can be reproduced on substituting a receiver for the transmitting-coil, according to the well-known action of the telegraphone. By changing the connections of the magnets, as shown in the second of our figures, the polarity of one is reversed. In this set of magnets, the original message cannot be reproduced, because each magnetic condition in one of the strips will be equal to the corresponding condition in the other, and as they oppose each other in the magnets, there will be no current in the circuit and silence in the receiver; but while the magnets are thus connected it is possible to fix on the two steel strips an entirely new message, which will not in any way obliterate the first message and which can be reproduced, while the connections will remain the same and will not prevent the reproduction of the first message when the connections of the magnets are changed back to the conditions illustrated in the first diagram. It is not necessary to use separate recording strips for each magnet; for the desired results can be obtained by using a single strip. It is necessary simply that the magnets shall act at different parts of the strip. In using a drum carrying the spirally-wound steel wire, the magnets should be arranged to effect two convolutions of the spiral. The third figure shows the application of the principle of varying combinations of magnets to the simultaneous transmission of several messages along the same wire. It is assumed that three messages are to be simultaneously transmitted along the line. At the transmitting end is a steel disk and at the receiving end a similar steel disk, both of which are simultaneously rotated in operation. Each station has three local circuits with four electro-magnets connected in different combinations. The combinations of the different circuits at each end correspond. The line circuit is connected at each end with an electro-magnet facing the corresponding disk. The magnetism created in the transmitting disk by the three different sets of magnets acting simultaneously thereon, will affect the magnet connected with the line and send impulses over the line, which will be received by the magnet connected with the receiving end of the line and impressed upon the receiving disk. The impulses created by the first circuit at the transmitting end are delivered to the receiver in the first circuit at the receiver end; in like manner two and three receiving circuits will select the messages delivered through the corresponding circuits at the transmission station. After the disk has passed all the recording and receiving magnets, it passes an obliterating magnet which cleans off the record, so that the disk can be presented to the recording magnets in condition to receive a new portion of a message.

NATURE OF THE ELECTRONS.—In an article entitled "Aepinus Atomized," Lord Kelvin sketches a system in which the single fluid of Aepinus consists of exceedingly minute equal and similar atoms, which he calls "electrons," much smaller than the atoms of ponderable matter. These permeate freely through the spaces occupied by ordinary atoms and also freely

through space not occupied by them. As in Aepinus' theory there are repulsions between the electrions, and repulsions between the atoms independently of the electrions, and attractions between electrions and atoms without electrions. The author assumes for simplicity that the attraction experienced by an electron approaching an atom varies exactly according to the inverse square of the distance from the center, as long as the electrion is outside; has no abrupt change when the electrion enters the atom; and decreases to zero simply as the distance from the center when the electrion, approaching the center, is within the spherical boundary of the atom. The author discusses several cases in which two atoms of different sizes, each containing an electrion, come into contact, and shows that under certain conditions both electrions may finally remain at the center of one of the atoms. The atom may contain more than one electrion. If, instead of two monelectrionic atoms we deal with two polyelectrionic atoms, we find after separation the number of electrions in the smaller atom increased, and in the larger decreased. This is a very remarkable conclusion, pointing to what is probably the true explanation of the first known of the electric properties of matter —viz., attractions and repulsions produced by rubbed amber. Two ideal solids consisting of assemblages of mon-electrionic atoms of largely different sizes would certainly, when pressed and rubbed together and separated, show the properties of oppositely electrified bodies; and the preponderance of the electrionic quality would be in the assemblage of which the atoms are smaller. The author makes some interesting applications of the theory to crystallography.—Lord Kelvin, Phil. Mag., April, 1902.

THE FOUILLARON AUTOMOBILE CARRIAGE.

THE new light carriage which M. Fouillaron is about to put upon the market has no other gearings than those of the differential. A belt of special form, two extensible pulleys and a special clutch-box are what M. Fouillaron employs for producing all speeds from zero to the highest that the power of the motor permits of attaining and for reversing the direction of the vehicle.

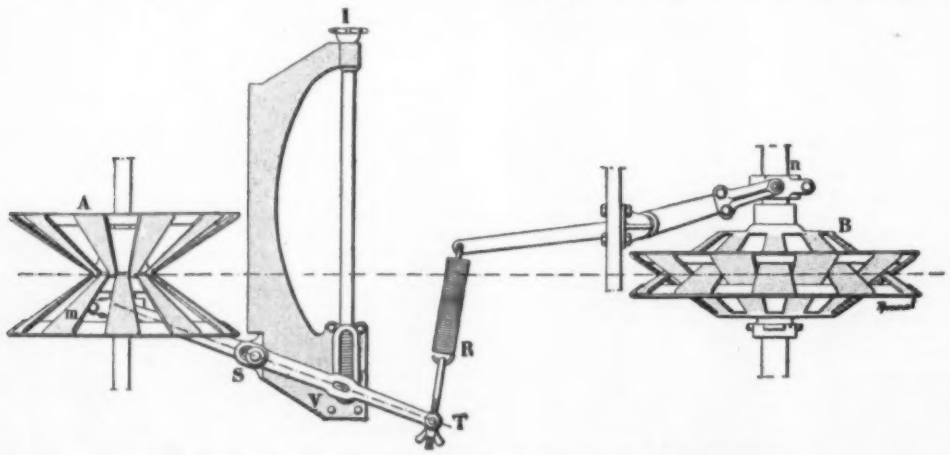
The extensible pulleys may be compared to two umbrella frames, of which the ribs engage with one another as shown in the figure. The shaft of the motor carries one at *B*, and that of the chain sprockets carries another at *A*. The two pulleys open and close in opposite directions, so that when *B* is entirely closed, *A* is entirely open. This is the position for high speed, since the diameter of the controlling pulley is as wide as possible and that of the controlled one is at its minimum.

The pulleys are thus capable of passing from simple to triple, that is to say that, according to the lead of the spark, it is possible to start with from 4.25 to 5 miles an hour and progressively reach from 30 to 36. The maneuvering is very simple. Under the steering hand wheel there is a second and slightly smaller hand wheel which, through a bevel wheel and chain, controls the toothed wheel, *I*, at the extremity of a shaft, *IV*. This latter, through its threaded extremity, engages with a square nut, which, through a lug in a slide, causes the lever, *MST*, to rise or descend; *S* remaining the point of articulation.

What happens? The belt exerts a traction upon the pulleys and tends to make them open. If the shaft, *IV*, be turned so that the point *T* shall descend, the point *m* will rise, that is to say, the pulley, *A*, controlled by such point, will close and therefore increase in diameter.

At the same time, yielding to the pressure of the belt and to the stress that the lever, *Rn*, exerts upon it, the pulley, *B*, will open, and therefore diminish. The speed of the carriage will diminish, since *B* loses and *A* gains in diameter.

On another hand, it will be understood that if we screw up the thumb nut situated at *T*, we shall draw upon the point, *n*, and consequently increase the diameter of the pulley, or in other words, we shall stretch the belt, since the diameter of the opposite pulley has not changed. The thumb nut, therefore, serves to stretch the belt, although there is often no need of this, since it is almost inextensible. In fact, the belt is formed of a succession of small, thin, triangular pieces of leather mounted upon three strong gut cords loosely twisted together in order that, under the effect of traction, they may not become bunched into a thick and inflexible mass.



THE EXTENSIBLE PULLEYS OF THE FOUILLARON CARRIAGE.

As for the backward running, that is produced by but one of the driving wheels. One pedal acts upon the box of the differential and renders it immovable, while the other connects the driving wheel operatively with the differential. It is, therefore, the strong spur wheels of the latter that become motors and produce the recoil.

The carriage is actuated by a De Dion motor.—For the above particulars and the illustrations, we are indebted to La Locomotion.

LAMPBLACK SKETCHES.

ONE would scarcely believe the pretty effects that can be obtained with lampblack in the hands of a skilled artist accustomed to working in it for decorative purposes.

In England, drawings and sketches in lampblack are at present much in vogue, and certain persons who are true "smoke" artists are obtaining a very decided success, as the reader will see from a glance at the reproduction of some of this work shown herewith.

The manner of procedure is very simple, all the materials necessary being an object with a smooth surface, a lighted candle, a penknife, and two or three camel's hair brushes. In ordinary painting, the effects are, in general, obtained by the laying on of pigments,

FIG. 1.—PICTURES IN LAMPBLACK ON PLATES.

FIG. 2.—LAMPBLACK DRAWING ON A VISITING CARD.

but here they are produced by the removal of the lampblack.

A porcelain plate provides an excellent surface for this kind of work. It must first be thoroughly cleaned, for the least trace of grease or moisture will compromise the result. After having deposited on the plate a coating of lampblack by means of the candle, the drawing is obtained by removing more or less of this lampblack, so as to produce the desired effect. In doing this, the artist makes use of the camel's hair brushes, the penknife, or even his fingers. If too much of the black is removed in this manner, it is easily renewed by the candle; and by thus retouching by means of the flame the soft tints that are particularly successful are obtained. When the drawing is completed, it is necessary to fix it, for it is very fragile and the slightest contact with anything would quickly spoil the pretty effect so laboriously obtained.

In order to make the design permanent, the plate is first heated slightly and then some thin transparent varnish is poured over it, spread out uniformly, and allowed to drain. In a few hours the varnish has set and the image is indelible. It is needless to state that any object with a smooth surface can be employed in like manner as a ground-work for these pretty decorative effects.

Drawings in lampblack greatly resemble charcoal-sketches, while the transparency of the deposit of black, when laid on lightly, permits obtaining effects in relief altogether unexpected. On account of the originality of this process and the facility with which it can be employed, drawing on smoked objects is coming more and more into vogue in England; so much so in fact, that a very successful exhibition of amateurs' work of this kind was recently given by the London Sketch Club.

This new drawing material, which is the fashion in England to-day, has been used a long time in France, with the production of original and amusing results. The writer remembers in his early youth often having, with great admiration, seen his parents make sketches in it for his amusement. They employed old visiting cards for their little chef d'œuvres. Their agile fingers held the back of a card over the flame of a candle in such a way as to thoroughly cover it with soot. With tints of different shades thus laid on at random, they knew how to improvise effects showing the full moon, old chateaux, and cascades or lakes, that were often very successful. One of the illustrations shows the moonlight on the water, with an old chateaux at one side. Instead of the brushes employed by the modern artist, they used bread crumbs rolled into little balls. To make the drawing permanent, it was only necessary to pour over it a light layer of the fixative employed with charcoal drawings.

The making of sketches in lampblack will be found an agreeable amusement during the long winter evenings, and compositions of more or less beauty can be obtained according to the taste and talent of the artist. —H. de Thiersant, in La Nature.

STEAM TURBINE NOT INVENTED BY HERO.

THE Iron Age, in presenting the subject of the steam turbine, says, "The thought suggests itself that the cycle of development in steam motors has brought us around very close to the starting point, and that this latest and in some respects most promising form of engine actuated by steam is, after all, a combination of Branca's wheel and Hero's eolipile. . . . The steam turbine combines the principles embodied in Branca's wheel and Hero's revolving eolipile in a modern mechanical expression . . . with no other important differences than that attributable to larger requirements and better appliances and materials for meeting them."

This is a sentiment frequently expressed by writers upon the steam turbine, but it contains more fiction than fact. We would wish to give old Hero full credit for what he did 2,022 years ago, but did he and Branca strike the keynote of turbine success when they invented their steam wheels? We think not. Both Hero and Branca used the same principles that had probably been employed centuries before in water wheels and in no respect were their wheels essentially different from water wheels, either in regard to the wheels themselves or the way in which the working fluid was employed.

The important inventions which made the turbine adapted to steam relate to ways and means for utilizing the expansive force of steam. When water impinges against the blades of a wheel it does not expand and no provision need be made for its expansion. But with steam it is different. Unless provision is made for this expansion, the turbine is absolutely worthless as a motor, which accounts for the fact that only within a few years, or since the invention of means for using steam expansively in a turbine engine, has the turbine met with any success for steam power. Neither Hero nor Branca knew anything about the expansive force of steam, nor anyone else for that matter, until about the time of James Watt. If the inventors of the modern steam turbine drew upon the knowledge of the past, it was not from Hero's or Branca's work, but rather from those who have developed the theory of modern water wheel construction, and from the designers of the reciprocating steam engine. From the one they learned how to properly proportion the blades and guide vanes of their wheels; and from the other the necessity for expanding steam to its utmost limit when using it for motor driving.

POSSIBILITIES OF AGRICULTURE IN SOUTH AFRICA.

MR. WILLCOCKS, who was for twelve years connected with the Irrigation Department of British India, and eighteen years with the Egyptian Irrigation Department, has prepared a report for the British government, regarding the irrigation of South Africa. The satisfactory irrigation of the late South African republics is developing into a serious question, since it is only by the construction of artificial waterways and reservoirs that the country can be more extensively opened. The country is essentially an agricultural one. Under the old regime the Boers were content to only cultivate that portion of the land that was conveniently situated near the rivers. The British government intend to open and develop the whole country, and this can only be satisfactorily accomplished by extensive irrigation. Mr. Willcocks advocates that all the important irrigation works should be in the hands of the state. Money spent by the government in this cause will be well and profitably invested. He also suggests that a quota of the money expended upon this object should be contributed by the mining companies. If the companies working the gold, coal and diamond mines should be compelled to devote a percentage of their gains to the purpose of irrigation works on lines laid down by the government, they would assist in the permanent development of the country, and would be investing in works which, though slow to give a remuneration, would at any rate be absolutely permanent.

If the irrigation works suggested by Mr. Willcocks be carried out, an additional 3,250,000 acres of perennially irrigated land will be available for agriculture. With the aid of its rainfall and the Orange River the Cape Colony should be able to insure the perennial irrigation of 1,000,000 acres, the Orange River Colony of 750,000 acres, and the Transvaal 500,000 acres in the high-lying regions where Europeans can live and work, and 1,000,000 acres in the low tracts,

There would be thus secured to South Africa an inestimable accession of permanent wealth.

The cost of the works is estimated at $150,000,000, which, however, would result in an agricultural value of $500.000,000, and if the rainfall over an area of another 1),000,000 acres were carefully stored, this would represent another $500,000,000.

A NEW BLEACHING PROCESS.

AT the Glasgow Exposition, Messrs. Mather and Platt, of Manchester, presented a new process of bleaching fabrics characterized by the fact that, during the entire course of the operations, the fabric remains wound in a piece around a cylinder instead of running over a series of rollers, as in the majority of the present processes. As the fabric is submitted to no mechanical operation, there is no risk run of its being injured, and a more satisfactory product is obtained. Fig. 1 represents a plan of the installation, which comprises a boiler, a carriage carrying a cylinder upon which the fabric is wound, a saturating bath, in which the piece is revolved by rollers, a revolving plate, a winch for actuating the carriage, and a vat for the last baths and the washing.

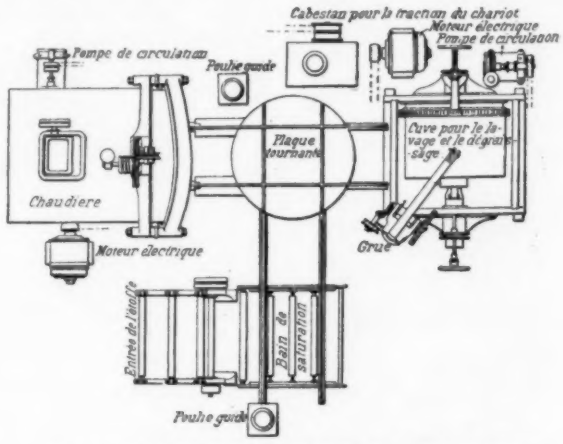


FIG. 1.—PLAN OF THE MATHER AND PLATT APPARATUS FOR BLEACHING FABRICS.

The operations are effected as follows: The fabric is first saturated with a hot alkaline solution, and during this operation the piece is wound upon a cylinder that carries a perforated plate at one of its extremities. The winding is done in such a way that one edge of the fabric shall be strongly pressed against the perforated plate. A second plate (non-perforated) is situated at such a distance from the first as to leave between it and the latter space for a suction chamber, of which the periphery is provided with teeth that engage with a pinion, which gives the whole a slow rotary motion.

The carriage, which carries about three-quarters of a ton of material saturated with the alkaline solution, is introduced into the horizontal boiler, of which one of the extremities is removable. After the cover has been put in place, the liquid is admitted into the boiler, traverses the entire mass of the fabric and flows into the suction chamber, whence it is removed by a centrifugal pump. During this time, the fabric is submitted to a slight rotary motion. The circulation of the liquid takes place between the spirals of the piece, from one selvage to the other, with absolute uniformity. The working pressure in the boiler is 39 pounds to the square inch.

After a sufficient circulation of the alkaline solution, the latter is replaced by water, and the fabric is thoroughly washed. The carriage is then removed from the boiler, and the fabric, still wound upon the cylinder, is, through a winch, made to enter a vat, in which the following operations are effected:

Into this vat are introduced the various alkaline, acid and chloric solutions; and, in it the washing with water and the circulation through the fabric are effected, as in the boiler, by means of a suction chamber; the piece, as before, being submitted to a slow rotary motion. This apparatus, the description of which is borrowed from Le Genie Civil, may be employed not only for the bleaching, but also for the dyeing of fabrics.

Fig. 2 represents a double boiler into which may be introduced two carriages, one at each end.

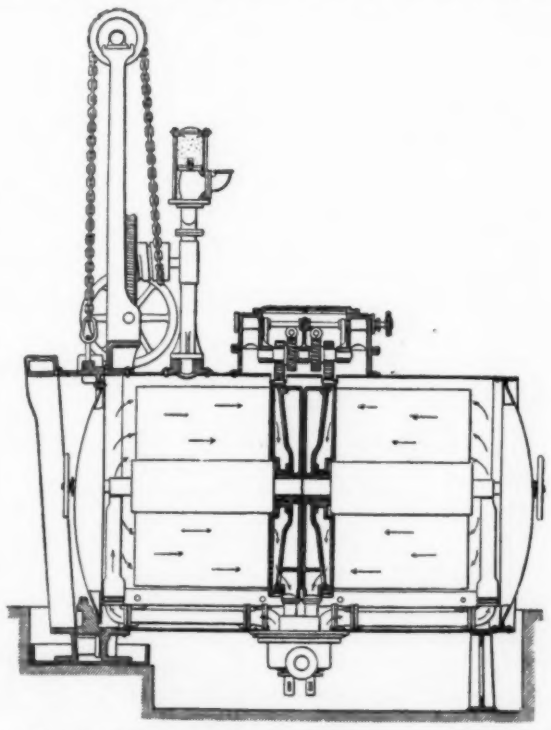


FIG. 2.—LONGITUDINAL SECTION OF A DOUBLE BOILER FOR THE BLEACHING AND DYEING OF FABRICS.

DIAZO PHOTOGRAPHIC PRINTING.

ACCORDING to the Berlin Chemical Society, some interesting experiments have been carried out by Messrs. Otto Ruff and Victor Stein in connection with the diazo photographic printing process. Eleven years ago it was discovered that aromatic diazo compounds are, as a class, sensitive to light, and during exposure decompose with the evolution of nitrogen gas. Working on the lines suggested by this discovery, Messrs. Ruff and Stein have prepared new azo derivatives, and to some extent traced the relation of constitution to greater or less sensitiveness, and simplified the working of the diazotype printing process. Incidentally to the study of carbazol a large quantity of the corresponding amido-carbazol was prepared, and the diazocarbazol was found to be of easy preparation by the usual methods, and also fairly stable, while its compounds with phenols and amines proved permanent.

All these circumstances pointed to the possibility of basing a practically useful printing process on the employment of the diazo derivatives in question. Paper treated with a solution of the diazo derivative is highly sensitive to light; and if exposed under a positive will give a positive, if developed with a solution of a suitable amine or phenol, the diazo derivative being decomposed by the action of the light. In practice the paper is sensitized with a double compound of zinc chloride, and the chloride of the diazol derivative, a 2 per cent solution being employed. Well-sized photographic paper is used, hardened by means of formalin. The exposure under the positive is continued until the subject appears bright bluish on a yellowish ground. A 1 per cent and slightly alkaline solution of naphthol is used to develop the impression. In this solution the image becomes orange yellow, but a bath of dilute acetic acid changes the color to a fine brown, while by using other developing agents a varied range of tone can be obtained. For instance, paper sensitized with a solution of 2 grammes of sodium salt and 2 grammes of naphthol in 100 cubic centimeters of water gives a brownish red image, which may be fixed by treatment with hot water, very weak soda solution, weak acetic acid, and finally cold water.

The general conclusions as to the influences of the constitution on the sensitiveness of aromatic azo derivatives are as follows: In the case of the para-substituted glass, the introduction of a negative element generally increases sensitiveness, but chlorine appears to be an exception. The negative nitro group increases sensitiveness most when in the ortho position, less in the para position, and least in the meta position. The positive methyl group has an analogous effect, but reversed, the sensitiveness being lessened. As a general rule, the sensitiveness of the diazo bodies increases with the number of atoms in the nucleus. It has further been shown that the sensitiveness of these compounds is much increased by association with the various colloids, which can be used as printing surfaces, and with regard to the modern theory of electrolytic dissociation and the saline character of all photosensitive compounds hitherto used, a further study of these compounds may be expected to contribute to the advance of the theory of photographic action.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

New Duties in Guatemala.—Consul-General J. C. McNally, of Guatemala, under date of May 9, 1902, sends translation of a decree issued by the government of Guatemala relative to new duties and articles to be admitted free, which reads in substance:

The National Legislative Assembly of the Republic of Guatemala, considering that the earthquakes that occurred on the 18th instant have occasioned awful losses in several towns, and that the President of the Republic has called a special session so that the Assembly may dictate the measures required by this national misfortune; considering that the legislative power is to take all the measures that can in some way alleviate the effects of the disaster, and that the establishment of several taxes of a transitory character will assist in helping the families of the sufferers, decrees:

Article 1. For five years from the 1st of May next, the following additional taxes shall be collected:

(1) Ten cents (0.4 cent) on each bottle of alcohol, which, of the capacity dictated by law, comes out of the deposits for consumption.

(2) Ten per cent more on the fee paid for the license to sell liquor or alcohol.

(3) Twenty per cent more upon the duties of importation on wines, liquor, and beer coming from abroad.

(4) Five pesos* ($2.06) yearly for each manzana (a square measure of 100 by 100 yards) of sugar cane in all plantations exceeding 5 manzanas.

(5) Ten per cent more in gold upon the import duties on tobacco in leaves or manufactured.

. . . . . .

Article 8. For two years, the importation of the following articles will be free of fiscal duties:

Tar and carboline.
Water pipes of galvanized iron.
Wood or iron houses, complete or in parts.
Cement.
Galvanized iron plates for roofs.
Iron or wooden pillars and annexes.
Wooden or iron doors and windows.
White oil paint and roof tile of any kind.

Duties in the Canary Islands.—Under date of April 24, 1902, Consul S. Berliner, of Teneriffe, says:

The syndicate† which received the concession to collect customs duties here has been compelled to give it up, forfeiting the 500,000 pesetas (about $70,000) guaranty. The concession has been granted to another syndicate, composed of the former company and of the principal merchants of the Canary Islands, each party having a half interest. Under the new contract with the Government, the price to be paid is 1,002,000 pesetas (about $140,000) per year, and the concession is for five years. It is proposed to reduce the duties on several articles which at present pay a very high rate, thereby increasing the importation.

Arsenic and Galena Mines in the Pyrenees.—North of Barcelona, in the heart of the Pyrenees, some 9,000 feet above the level of the Mediterranean, is located a mining property which covers a surface of over 16,000 acres, or 6,500 hectares, and is worked by Messrs. Girones & Henrich, of Barcelona. The mineral wealth of this spot has been known from ancient times. Iron was worked here on a large scale until the middle of the nineteenth century. The valley of Ribas is the cradle of the well-known Catalan furnaces, ruins of some of which can yet be seen. When the forests that covered the slopes of the mountains disappeared—all wood having been burnt for the furnaces—the working became impossible. Although iron is the least important of the minerals to be found in that district, the ore contains 54 to 60 per cent of metal; but copper to 4 per cent, arsenic to one-half of 1 per cent, and phosphorus and sulphur in excess render the ore very difficult to use for large industrial purposes.

Since 1840 other minerals have been sought for, and mispickel containing an average of 45 per cent arsenious acid, with from 10 to 16 dwts. of gold, was worked with advantage. The tremendous fall in the price of arsenic, together with the practical impossibility of transport (to take a ton of ore from the mines to Barcelona costs more than $100), caused the ruin of the enterprise. Subsequently, a powerful French company was floated with the sole object of

* The Guatemalan peso was valued by the United States Mint, April 1, 1902, at 40.3 cents.

† Advance Sheets No. 774; Consular Reports No. 240.

extracting the gold contained in the ore, but the enterprise could not succeed, as the small percentage of gold did not cover the expense of treatment; besides which, in burning the ore in free furnaces, the whole valley was poisoned with the arsenic, and the company was obliged to pay a very large sum to indemnify the owners of cattle and crops.

It is only in the last few years that Messrs. Girones & Henrich purchased the mines and began working them on a paying basis. After having thoroughly investigated the ground, they explored the most powerful veins and succeeded in extracting over 3,000,000 tons of mispickel, of which several thousand tons were exported to England and other countries of Europe. The results of the sale of their ores, and especially the prices obtained from the residues after calcination, induced them to erect works at Badalona, a small town on the Mediterranean 4 miles from Barcelona. Besides the arsenical pyrites, they work the rich galena veins, containing an average of 53 per cent of lead, 60 ounces of silver, and 12 dwts. of gold to the ton, as well as the copper veins of about 23 per cent metallic copper and 20 dwts. of gold to the ton.

A large metallurgic plant, as stated, has been erected at Badalona for the treatment of arsenical, copper, lead and silver ores. It occupies a surface of 18 acres. Part of the plant is in full working order and will treat 30 tons of arsenical ore per day. It has been erected by English engineers and practical burners for the production of the very best quality of arsenious acid (As_2O_3), which is exported. The arsenious oxide is absolutely free from any impurity or metal.

At a very early date the plant for the treatment of lead and the extraction of silver from the galena produced in the mines will be erected. At the same time the residues of the arsenical and lead ores, and a special mud to be found in large quantities on the surface of some of the mispickel mines at Ribas, will be treated, and a new plant for working these products will be in operation before the end of 1902.

The firm has commenced exporting arsenious acid to the United States, where, it is expected, the product will have the same success as in other countries.—Julius G. Lay, Consul-General at Barcelona.

Combination of British Columbian Salmon Canneries.—Consul L. E. Dudley, of Vancouver, reports, under date of May 19, 1902, that the salmon canneries of British Columbia have combined and will extend business in several directions. The combination is said to be capitalized at $3,000,000. Heretofore, says the consul, the by-products of the canneries have been almost entirely wasted, but it is now proposed not only to save the oil, but also to manufacture guano and glue. The combination will undertake to develop the entire fishing industry of that region. Shipments of fresh halibut will be made, and efforts will be put forth to meet the demand for salted and smoked fish in the Orient, Europe and the United States. The consul adds that it is understood that a considerable portion of the capital of the new organization came from the United States.

The Rubber Crop of Brazil.—The shipments of rubber from the Amazon Valley were, up to April 30 last, a few hundred kilograms in excess of the entire crop of the season of 1900–1901. The total increase, however, will not be known until the remaining shipments are made in May and June. The best informed rubber buyers here estimate that it will amount to at least 10 per cent of the previous crop, and that the total yield will be about 30,000 tons.

Owing to hard times, low prices, and certain unfavorable local conditions, there are various opinions as to whether the steady increase in the output of rubber during the past few years will be maintained in 1902-3. It is generally believed, however, that the rapid development of the new rubber districts on the Upper Amazon River and its affluents will more than make up for any falling off from these causes. I am informed that already many large bands of rubber gatherers are organizing, and that preparations on a large scale are being made for harvesting next season's crop.—K. K. Kenneday, Consul at Para.

Prize Competition for Buildings at Nice.—Vice Consul A. Piatti writes from Nice, May 12, 1902:

The municipality of Nice has offered annual prizes for the construction of buildings in this city, public and private. Their fronts, their interior plans, their construction and the excellence of the materials, their sanitary systems, and their gardens facing public streets are all to be considered in awarding the prizes.

The building industry of Nice is in its infancy, as to heating, ventilation, and sanitation. In some of the newest buildings, the arrangements are still of the most rudimentary kind. In one kitchen, the work is all of cement.

I would earnestly recommend our manufacturers of articles in this line to seek an opening here by doing a direct trade with this port, instead of depending upon middlemen. This consulate will receive all catalogues, etc., and distribute them where a probability of business exists.

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No. 1362, June 9.—* Projected Improvements in the Harbor of Genoa—Municipal Bath Houses in Cologne—* The Rubber Crop in Brazil—* Prize Competition for Buildings in Nice—Lead Bounties Urged in British Columbia—Manchurian Merchants in Russia.

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No. 1366, June 13.—Manufacture of Iron in New South Wales—* Alleged Shipments of Rice to the Danish West Indies.

No. 1367, June 14.—* American Commercial Travelers in the Orient—Railway Extensions in Mexico—Trade and Transport Association in France—* Commercial Traveler Tax in Jamaica.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

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